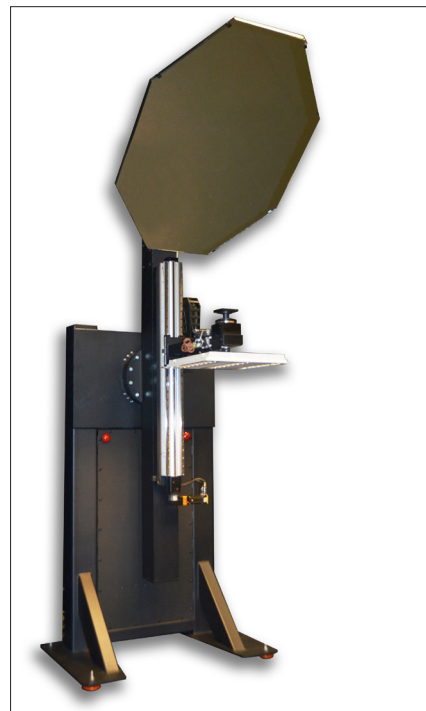


# Type C Goniometer

Used to measure lamp and luminaire output, efficiency/efficacy, intensity distribution and zonal lumen density



## Expertise

Over 35 years of leadership in light metrology enable Labsphere to offer the Type C Mirror Luminaire Goniometer Series as the standard of the lighting industry.

## Accurate

The Type C Goniometer Series delivers high speed, easy operation with accurate results. State-of-the-art hardware and control, coupled with sophisticated data collection provides an easy and practical fully-automated test system for testing luminaires, lamps and other lighting fixtures by generating IES files for lamps and luminaires.

## Save Time

The high value, high performance of the Type C Goniometer Series can significantly cut your development time and cost by not having to send your light products out for third party testing. Managing test and characterization in house protects your IP throughout development.

# Labsphere Goniometer Benefits Summary

- The goniometer is designed for testing lamps, luminaires and other non-application specific lighting system. (not for use with automotive or aircraft lighting)
- For luminaire tests, easily create the IES data formatted files compatible with leading design and data analysis software tools for creating detail reports in industry standard and flood formats.
- Includes software program to automatically align test results of directional lamps which are not fully aimed, leading to better test results with faster lamp set up times.
- Complete turnkey solution including goniometer, optometer and photodiodes, CCD spectrometer, control rack and electronics, temperature sensors, lamp standard, computer and preprogrammed control software, display, keyboard and mouse.
- The detector remains at a fixed height in reference to the lateral axis of the lamp. During the test; the goniometer rotates a mirror around the lamp creating test results from a lamp testing in typical operating orientations.
- System can be designed for lengths as short as 25 feet and as long as 50 feet.
- Direct view spectrometer attached to rotating arm creates high signal results, which when combined with industry leading stray light and filter light management creates repeatable spectral data.
- Includes interchangeable optical density that allow test over a high dynamic range of lamp intensities.
- Optometer and customer photodiode combinations allow for very precise measurement ranges, as low as 0.1 cd and as high as 10,000,000 cd.
- Fixed and auto ranging CCD spectrometer for spectral intensity and color uniformity.
- Automatic dark current compensation reduces errors and boosts accuracy.
- Includes NIST traceable spectral intensity standard for user calibration at any time.
- Hardwired 4 pole power connector box plus easy wire feedthroughs for simple lamp interchange and with no light interference from cabling.
- Machined grid pattern mounting plate and motorized vertical table make mounting many different lamp types and sizes quick and easy.
- Precision drives provide unrivaled accuracy.
- High-speed data collection and point-to-point options for accurate data collection.
- Temporal stability data for measured thermal, photometric and electrical data.
- High-quality construction delivers years of trouble-free performance.
- An extremely strong steel framework allows the safe attachment of heavy luminaires.
- Backed by Labsphere, the foremost producer of light metrology systems.

# Goniometer Components

The Type C Goniometer consists of the following basic components:

## Mirror Swing-Arm and Support Structure

The height of the test luminaire or lamp is fixed on a 360 degree rotating lateral axis. The arm rotates in circles around the vertical axis, eliminating constant repositioning of the test item to different heights.

## Detector Housing

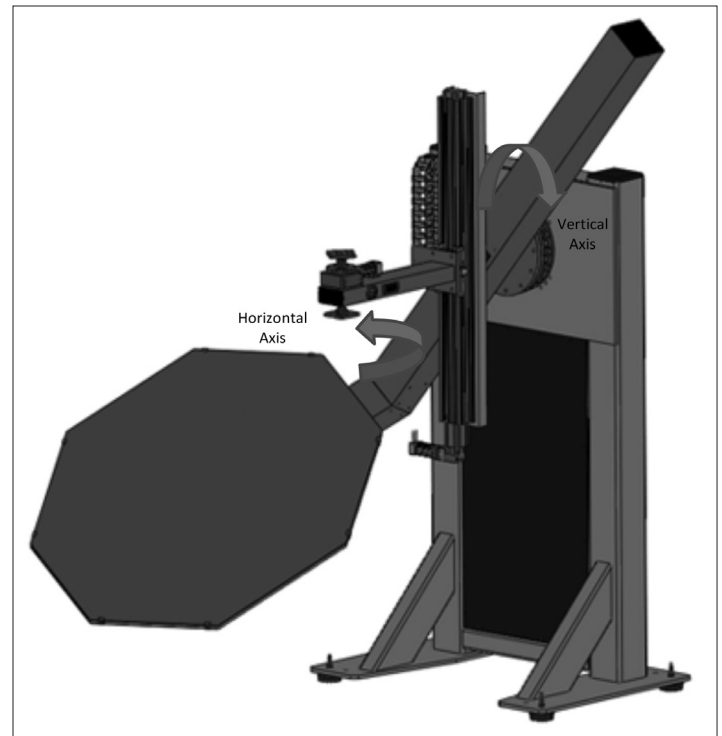
A shielded unit houses the detector heads that feeds back to a high-dynamic range optometer that is used to obtain the photopic and chromaticity data. The optometer is calibrated over the visible spectrum. The data is relayed to the computer interface via serial interface connection for long distances.

## Goniometer Integrated Console

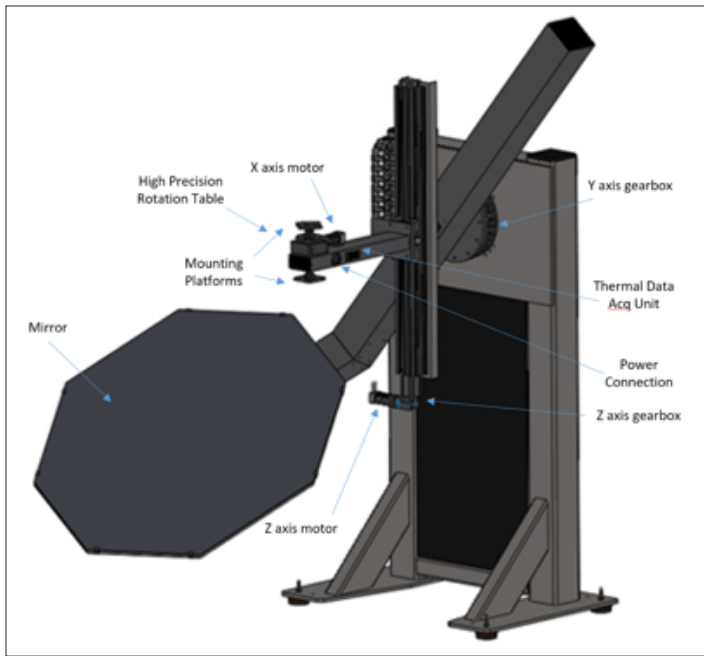
This unit contains all the system's electric and electronic equipment including main power switches, power supplies, power analyzer, motor controllers, computer and computer interfaces.

## Computer Station

This includes a computer and the goniometer control software to control the operation and data collection functions of the goniometer during testing. All information controlled and collected is displayed on the computer monitor. Additional automated software produces IES and Excel files for full data analysis.



# Component Features



## Mirror Swing-Arm and Support Structure

The main vertical swing-arm and lateral access mounting assembly are all engineered and manufactured to produce the most stable test platform available. Precision assembly ensures that the mirror swing-arm is balanced to provide for continuously accurate alignment throughout all rotational positions.

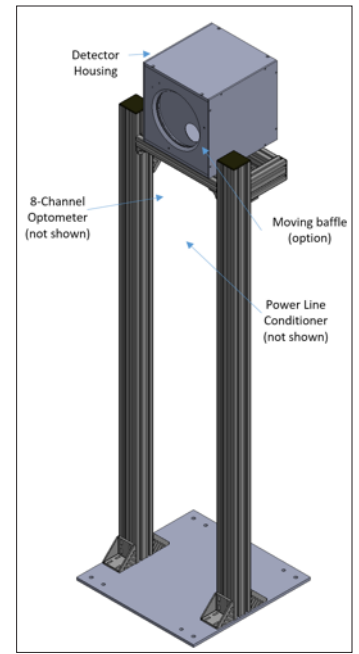
The test luminaire or lamp is mounted at a height in the center of the lamps lateral axis and referenced to the detector optical axis throughout the test. The lamp rotates about the horizontal axis.

The lamp or luminaire is positioned at the goniometer's vertical axis which allows it to accommodate a variety of fixture heights up to 0.75 meter, by 1.2 m in diameter.

Precision digital motors are coupled to the vertical axis shaft and the luminaire rotation shaft, and are constantly monitored by the system's encoders, ensuring the swinging arm position and the luminaire angles are precise throughout the test sequence. Resolution of each motor of the Type C Goniometer is an extremely fine 0.01 degrees.

## Detector Housing

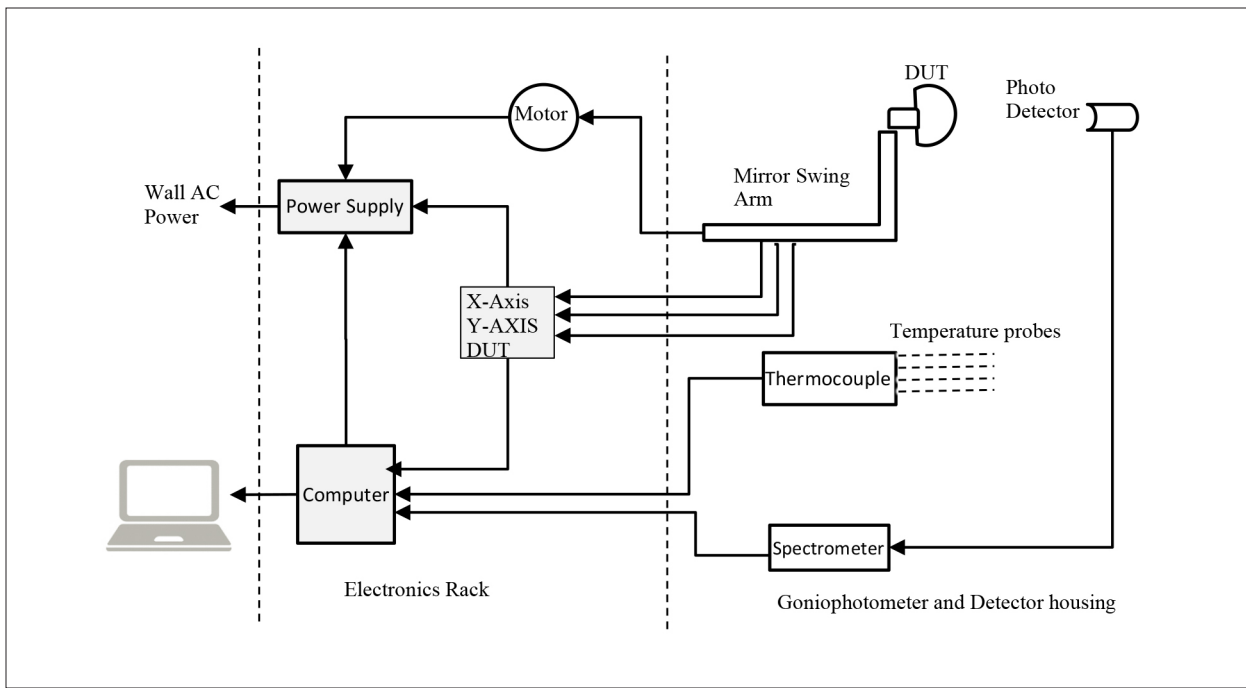
The detector tree contains all components needed to measure the intensity and color (tristimulus in detector housing, spectrometry on moving mirror arm) of the lamps under test. The primary detector is mounted at the centerline of the optical system, a manually actuated arm moves the 4 channel photopic head into or out of position with the 4 channel tristimulus detector head.



## Computer Control Rack

The control rack houses all of the automation and controllers to operate the goniometer. Contained within the control rack are the computer, power supplies, safety system, power analyzer, computer monitor, keyboard and mouse.





### Spectrometer Sensor

The sensor is an Ocean Optics Flame CCD Array Spectrometer. The highly sensitive CCD Array Spectrometer offers low noise and a broad spectral response with calibrated ranges from 200 to 850 nm. For use with the Type C Goniometer it is used for the visible range of 380 to 780 nm. When coupled with a Type C Goniometer the spectrometer avoids the inherent photometric errors associated with filter-based photometers by correcting measurements to  $f'$  near 0%. The multi-channel spectral analyzer is designed for real-time spectral analysis. The instantaneous spectral acquisition provides the radiometric, photometric, and color characteristics of the lamp or luminaire. The fast results help to maintain high scan rates, excellent linearity and low drift, and is housed in a shielded chamber. The optical fiber field of view helps to exclude stray light not emitted directly from the luminaire itself. This serves to block stray light from room surfaces by allowing the optical fiber to collect light only from the intended source.

The housing has a thread end compatible with the 2.54 cm optical density filters included with system. The optical filters can be threaded onto the housing in the beam path. Filter corrections are applied in software. The optical filters allow for attenuation of high intensity lamps from saturating the sensors, increasing the sensitivity and dynamic range of the system.

The spectrometer is calibrated for spectral content which is used to determine color distribution. The spectrometer can be calibrated at any time by the user using the spectral intensity lamp standard provided with the system. Dark correction is measured during calibration with the standard lamps and applied with every measurement thereafter.

The spectrometer is housed in the moving mirror structure. It is interfaced to the goniometer console computer via wireless Ethernet.

Note: There are significant trade-offs associated with a spectrometer in the mirror system, please contact technical support to fully discuss the right solution for your testing applications. In most cases, a tristimulus head connected to the optometer will meet your needs.

## Goniometer Console

This component contains all of the system's electrical and electronic controls. Main power switches and lamp voltage input, power analyzer and computer are included in the goniometer console. A bundle of cables is routed between the control rack and the main goniometer body.

### Three options are available:

#### **Option 1:** DC Power Supply, no Power Analyzer:

With this option the Chroma 62006P-300-8 DC Power Supply is included and mounted in the console.

The lamp power can come from the Chroma 61603 DC Power Supply, main line or an independent external power supply. If from the Chroma 61603, the power to the lamp is controlled via the system control software. The voltage to the lamp is routed directly to the lamp, independent of the console.

#### **Option 2:** DC Power Supply and Power Analyzer:

With this option the Chroma 62006P-300-8 DC Power Supply and the Yokogawa WT 310E Power Analyzer is included and mounted in the console. The lamp power can come from the Chroma 62006P-300-8 AC Power Supply, main line or an independent external power supply. If from the Chroma 62006P-300-8, the power to the lamp is control via the system control software. The current from the power supply is routed through the power analyzer.

**Option 3:** DC Power Supply, AC Power Supply and Power Analyzer: This option includes a Chroma 62006P-300-8 DC Power Supply, Chroma 61603 AC Power Supply and the Yokogawa WT 310E Power Analyzer mounted in the console. The lamp power is fully computer controlled for either AC or DC operation, with automatic relay switching to deliver the right voltage to your lamp.

A Yokogawa Power Analyzer Meter is installed which incorporates a large digital display of volts, amps and watts. The meter measures the exact lamp characteristics by use of remote sensing leads to the test luminaire. Measurement of Power Factor and Total Harmonic Distortion is available.

## Computer and Software

The functional heart of the Type C Goniometer is the computer hardware and software which control the system's entire operation. Virtually all functions of the system are computer automated including the vertical mirror arm rotation, horizontal axis rotation, selection of data points, control of power supplies and the recording of data.

The computer system provided with the Type C Goniometer consists of MS Windows based equipment totally configured and integrated to provide full system operation, data collection, processing, fully licensed Microsoft Excel and data file outputs.

### Control Software

Comprehensive software controls the operation of the Type C Goniometer and gathers the appropriate test data for the particular type of lamp or luminaire being tested. Standard test formats for most outdoor and indoor luminaires, floodlights, spotlights and bare lamps may be created and saved by the test operator from easy-to-use menus. All supplied test sets can be customized per the customer as well as created per customer requirements.

The software is MS Windows 7 based. It allows automatic or manual operation of the system with pre-stored horizontal (lateral) and vertical angle formats for commonly-used test procedures. Test data is automatically collected and stored in PDF files or IES data formats.

### Data Processing Software

Upon completion, spectral intensity spatial scans of the lamp or luminaire are processed to compute luminous intensity, x, y, CRI and CCT and saved in IES data format for further analysis. (This option is only available when the spectrometer or tristimulus options are selected.)

Data can be exported to external spreadsheet software where the spectral intensity at every angle as well as intensity and color are reported.

#### Data Presented During Scans

- Intensity (candlepower)
- Set and Actual Angles
- CCT
- Sensor Saturations Levels
- Chromaticity x and y
- Axial Plot

### IES Formats

Labsphere's software supports IES testing formats for analysis and reporting.

## **Lamp and Luminaire Size**

See Specifications: Custom-designed equipment to handle or mount different luminaire sizes and to fit customer's specific lamps and luminaires also available. Please request information. Standard size Type C can handle luminaires up to 1.2 m tall x .6 m wide and a weight up to 30 kg (greater weight up to 60 kg can be tested, please request at time of order higher max weight to support your needs.)

## **Lamp Standards**

A lamp standard is included. The lamps are calibrated in Labsphere's industry leading light metrology labs in reference to NIST. Optional additional lamps are available in sets of three.

The lamp standards are calibrated for directional spectral intensity. Software routines are provided for user-selectable goniometer calibration. Calibration routine is fully automated and logged for traceability to standards.

## Included Items

### Hardware:

- A goniometer supporting the main vertical mirror swing arm and horizontal shaft
- The horizontal swing arm motor, temperature monitor, and spectrometer are enclosed in main arm of the goniometer chassis
- A precision rotating vertical axis incorporating 330° degrees' rotation of the arm around the test luminaire emitting surface
- A precision rotating horizontal (lateral) axis incorporating 360 degrees' rotation fitted with a low profile lateral (horizontal) axis enclosed with black metal sheathing
- A horizontal framework holding a lateral shaft, onto which plates are attached for mounting of the lamp or luminaire from above or below
- Means for adjusting the depth of the horizontal arm which holds the vertical shaft and luminaire, using motorized high precision rail system
- Vertical rotation drive motor, which is a high-precision digital stepping motor operating under computer control, manually or automatically
- Lamp/luminaire rotation drive motor, which is a high precision digital stepping motor operating under computer control, either manually or automatically
- A high dynamic range spectrometer calibrated for spectral intensity over the visible spectral range (optional)
- A housing for the optical fiber and optical density filters
- Ambient and DUT optical thermal sensors (optional)
- Optical density filter set (optional)
- Spectral intensity lamp standard and mounting fixture (optional)
- Edison socket base (optional)
- A console housing incorporating:
  - A Windows-based computer system and display with wireless keyboard and mouse
  - Goniometer electronic interface
  - DC power supply
  - Optional AC power supply
  - Optional digital power analyzer
  - Emergency off "panic" button (total of five, one on control rack, two on the goniometer base and two mounted on the walls)

### Software:

All software is Windows based. Standard data collection software package offering:

- Automatic or manual operation
- Automated and manual control of vertical rotation
- Automated and manual control of lamp/luminaire rotation
- Selectable vertical angle intensity steps
- Selectable lamp/luminaire rotation increments and angles
- Output in industry standard format (IES) or PDF file formats
- Single readings mode with the capability to input the desired vertical and lamp/luminaire angular location, with automatic rotation to selected angles
- Fully automated calibration software routines using standard lamps calibrated for directional spectral intensity
- LM-79 stabilization routine
- Temporal graphing data
- Operator selectable data collection vertical angles
  - Specify starting and ending angles, and step increment
  - Step increment as small as 0.01 degrees
- Operator selectable luminaire horizontal angles
  - Specify starting and ending angles, and step increment
  - Step increment as low as 0.01 degrees
- Output in industry standard format, or format compatible with Excel spreadsheet.



# Summary of Technical Specifications

Measurement Method	Far field
Type	Type C. Description in Appendix
Axis	V-plane axis automated, H-axis rotation automated
Operation	Fully automated save loading lamp samples and align process
Shipping Weight	~ 800 kg
Area Occupied by Goniometer	< 4.3 m x 4.3 m x 2.5 m (control rack .56 m X .64 m X 2.2 m)
Sensor Distance	7.6 m to 12.2 m
Device Limit Size	1.2 m x 0.6 m
Spectrometer	OceanOptics Flame
Max Lamp Weight	~30 kg (heavier up to 45 kg is available as needed)
Wire Routing	Axial feedthrough for system cabling and to allow customer to route their own source cables when needed
Electric Connections	90-240VAC, 15A, 50- 60-Hz x 2 circuits
Power Analyzer Voltage Range	12VAC - 240 VAC <+/- 0.2V
Power Analyzer Current Range	0A - 3A (Avg: +/- 0.1mA)
Power Analyzer Power Range	0W - 200W (Avg: +/- 0.001W)
Electrical Measurements	Lamp Power factor, voltage, and current
Lumen	1 - >10000
Intensity Range (cd)	0.1 to >1,000,000
Color Temperature	1000K to 10,000K +/-35K (with spectrometer option)
Photometric Accuracy	0.1 cd (0.2%+0.5% range) 12-16 bit f' < 3% (f' <0.5% available) 0.1 cd
CRI	0-100 +/- 0.7 (with spectrometer option)
UI	Interface(s) to entering control and test parameters and display measurement results
Operating System	Windows 7
<b>Angular Rotation</b>	
Angular Resolution	0.01 degree /step
Speed	Up to 6 RPM
	Can assume symmetry in distribution: Minimum of 2 C planes (orthogonal to each other) should be measured to predict symmetric LID
	Report Generator per LM-79 with option to include user logo (productivity in reporting)

## Report Inputs

## Descriptive Information

- Date and testing agency
- Manufacturer's name and designation of product under test
- Lamp category
- Lamp or luminaire
- Ambient temperature
- Power factor
- THD
- Current
- Voltage
- Warm up

## Report Inputs (continued)

## Descriptive Information

- k) Lumen
- l) Lamp characteristics reported based on lamp type
- m) Measurement quantities measured (angles, luminous intensity, total luminous flux, luminous efficacy, etc.)
- n) Rated electrical values (AC (frequency) or DC) of product tested
- o) Total operating time of the product for measurements including stabilization
- p) LM-79 stability procedure using intensity measurement at a fixed point
  - Ability to save warm up intensity data
- q) Ambient temperature
- r) Orientation (burning position) of product during test
- s) Photometric method or instrument goniophotometer
- t) Designation and type of reference standard used (wattage, lamp type, intensity distribution type - Omni-directional/directional)
- u) Correction factors applied (e.g., spectral mismatch, intensity distribution, etc.)
- v) Photometric measurement conditions: photometric distance
- w) Measured total luminous flux (lm) and input voltage (V), current (A), and power (W) of each SSL product
- x) Luminous intensity distribution (IES.net)
  - i. Peak intensity
  - ii. Cone illuminance
  - iii. Beam angle
- y) Color quantities (chromaticity coordinates, CCT, and CRI) with spectrometer option
- z) Spectral power distribution
- aa) Color uniformity
- bb) Bandwidth of spectroradiometer
- cc) Equipment used
- dd) Statement of uncertainties (Labsphere) Deviation from standard operating procedures, if any
- ee) Designed with full scale stray light correction routine (accuracy)

## Data Format

\*.PDF Report, \*.IES IESNA file format, and \*.idt

## Traceability (where applicable)

NIST

## Optional Equipment

Available optional equipment consists of individual accessories or complete systems providing enhanced capabilities.

- Edison Based Lamp Type Mounting Fixtures
- Recessed Troffer Adjustable Mounting Fixture
- Tristimulus Color Measurement
- Spectrometer Color Measurement
- Thermal Data Acquisition
- AC Power Supply
- Higher capacity DC Power Supply
- Moving Detector Baffle
- NIST Calibrated Bulbs

Other accessories available, contact Labsphere sales representative for details or for custom requests.

The Type C Goniometer, with options, meets the applicable requirements of the following standards and recommended practices:

### **Commission International de l'Eclairage**

- CIE Publication no. 121. The Photometry and Goniophotometry of Luminaires CIE Publication no. 70. The Measurement of Absolute Intensity Distributions

### **Illuminating Engineering Society of North America**

- IES LM-35-02 Photometric Testing of Floodlights Using Incandescent Filament or Discharge Lamps
- IES LM-41 Approved Method for Photometric Testing of Indoor Fluorescent Luminaires
- IES LM-46-04 Approved Method for Photometric Testing of Indoor Luminaires Using High Intensity Discharge or Incandescent Filament Lamps
- IES LM-75-01 Goniometer Types and Photometric Coordinates
- IES LM-79-08 Electrical and Photometric Measurements of Solid State Lighting Products
- IES LM-80-08 Measuring Lumen Maintenance of LED Light Sources. (Applicable parts)
- IES LM-79-08 Measuring Solid State Lighting

# Appendix 1

## What is an IES file?

If you are in the Lighting industry, you've heard of IES files. But do you know what they are and why you need them? IES files refer to data sets built in accordance with ANSI/IESNA LM-63-2002. This is a global standard which defines the format for photometric data file storage, retrieval and transfers. In other words, the photometric data produced when you test and measure your lighting products needs to be presented in an IES file format.

## How are IES files used?

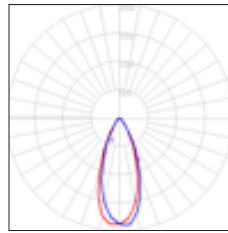
IES formatted photometric data help lighting professionals select products and options that are most appropriate for their requirements. The IES files also help developer's analyzer their product performance and marketing to generate product collateral. The files are in applications like Photometric Toolbox, Photometrics Pro, IES Viewer, Visual, Photometric Viewer, Economic Viewer and other commercially available software.

## How do you get IES files?

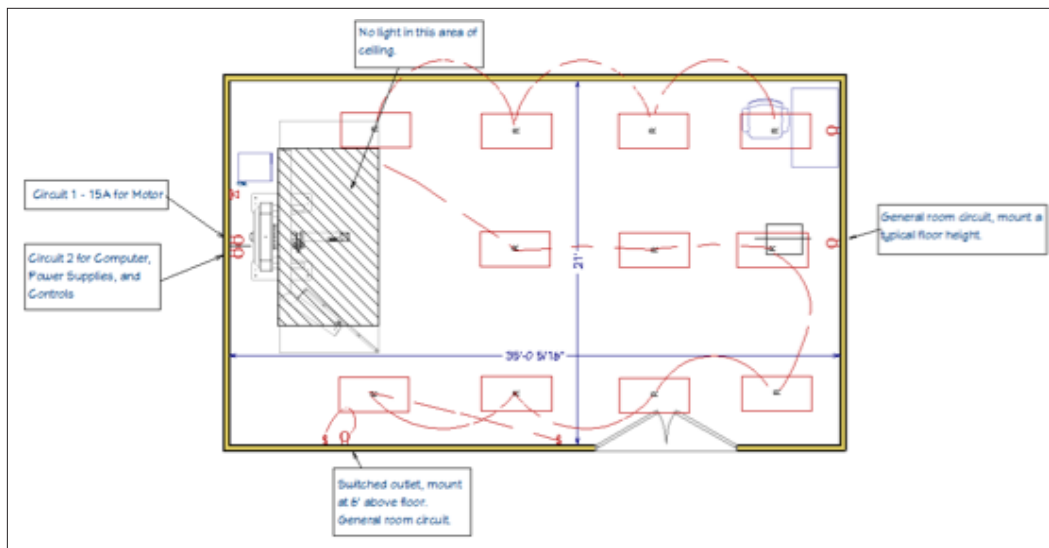
That depends on how you test and measure your lighting products. The most common method is with a goniophotometer or goniospectrometer. At Labsphere, we've made it easy to collect the photometric data and present it in approved IES file format by using our Type C Moving Mirror and Moving Detector Goniometers.

## Can I get Intensity Distribution Plots and IES Files?

In addition to complete data analysis, lamp and luminaire characteristics, and reports, the data can be viewed in 2D and 3D plots, Polar Graphs, Isocandela, and CU Graphs. For example, below is an example of a solid state PAR lamp.



**Axial Display of PAR 30 Lamp Measures on Lamps Type C Goniometer**



**Sample Room Layout**