

# A Type Goniometer

Used to measure automotive and signal lighting, and retroreflectors



## Expertise

Over 35 years of leadership in light metrology enables Labsphere to offer the Type A Goniometer.

## Accurate

The Type A Goniometer delivers easy operation with accurate results in the space of Type A. State-of-the-art hardware and control, coupled with sophisticated data collection provides an easy and practical fully-automated test system for testing automotive lamps to SAE, ECE and JIS standards, testing retroreflectors, as well as generating IES-A files.

## Save time

The high value, high performance of the Type A Goniometer can significantly cut your development time while saving time and cost by not having to send your lighting 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 automotive lamps, reflex, license lamps and heavy truck lamps, suitable for SAE, ECE, JIS and other International automotive standards.
- Create complete test reports with pass/fail criteria shown for all points and zones as necessary, including report of re-aimed test points.
- 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 standards.
- Complete turnkey solution including goniometer, optometer and photodiodes, optional CCD spectrometer, control rack and electronics, temperature sensors, lamp standard, computer and preprogrammed control software, display, and keyboard and mouse.
- The detector remains at a fixed height in reference to the lateral axis of the device under test (DUT). During the test; the DUT rotates about the horizontal and vertical axis on a Type A Coordinate System; when measuring luminaires includes automatic transfer of Type C Data Formats.
- System can be designed for lengths as short as 20 feet and as long as 100 feet. (for full certification of results)
- Limited field of view spectral sensor for reducing stray light.
- Includes interchangeable optical density that allow test over a high dynamic range of lamp intensities.
- Optometer and photodiode allow for very precise measurement ranges, as low as 0.01 cd and as high as 10,000,000 cd.
- Fixed and auto ranging CCD spectrometer for spectral intensity and color uniformity, or tristimulus detector options.
- Automatic dark current compensation reduces errors, boosts accuracy.
- Includes NIST traceable spectral intensity standard for user calibration at any time.
- Machines grid pattern mounting plate and vertical table accessory make mounting many different lamp types and sizes quick and easy.
- Precision drives providing 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 A Goniometer consists of the following basic components:

## Lamp Swing-Arm and Support Structure

The height of the test luminaire or lamp is fixed on a  $-180,+180$  degree rotating lateral horizontal axis. The arm rotates in circles around the vertical axis, eliminating constant repositioning of the test item to different heights.

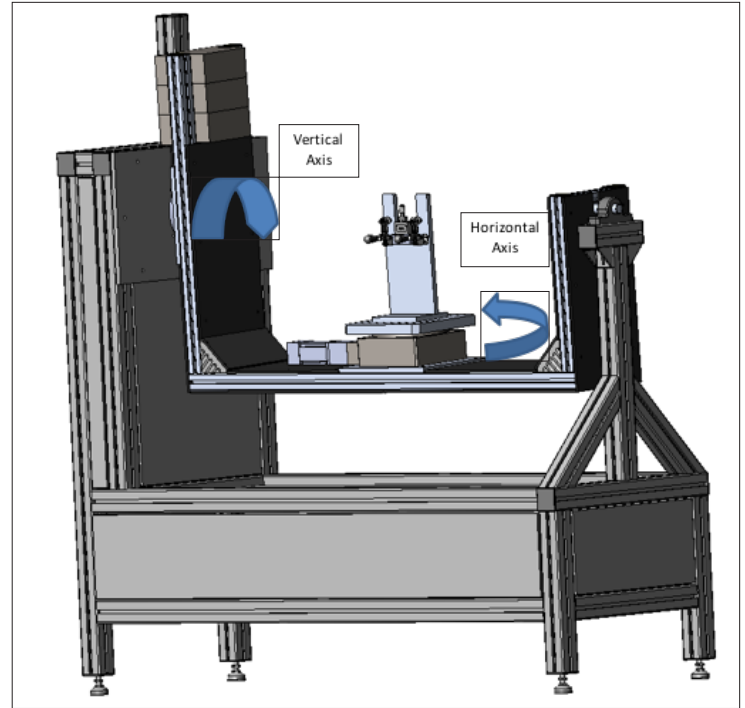
This component holds the DUT during testing and includes the sensor support on a rail, swing-arm, the rotating DUT mounting fixtures, power connections and temperature sensors.

## Goniometer Integrated Console

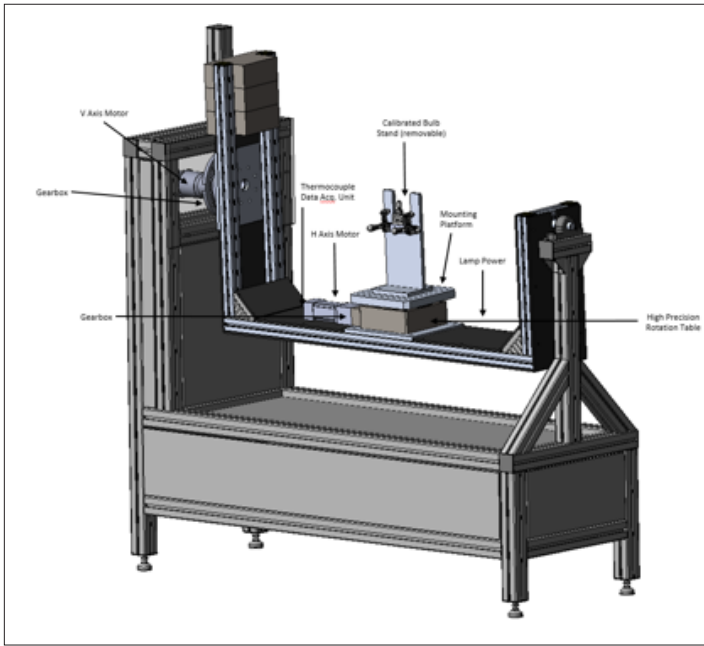
This unit contains all of the system's electric and electronic equipment including main power switches, power supplies, power analyzer, motor controllers and computer and computer interfaces.

## 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-A and Excel files for full data analysis.



# Component Features



## Lamp 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 lamp swing-arm is balanced to provide for continuously accurate alignment throughout all rotational positions.

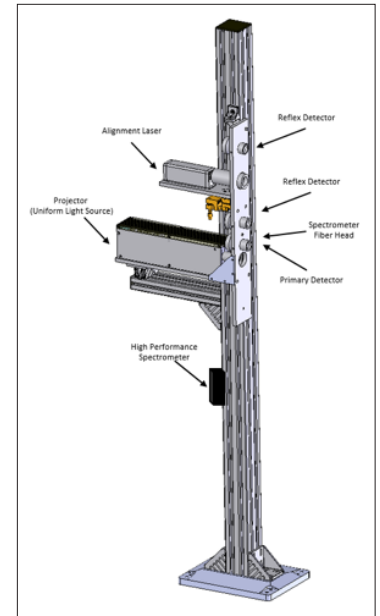
The DUT or lamp is mounted at a height in the center of the DUT lateral axis in reference to the detector optical axis throughout the test. The DUT rotates about the vertical axis in reference to the fixed sensor.

The DUT is positioned at the goniometer's vertical axis which allows the goniometer to accommodate a variety of tall fixtures up to 0.6 meters.

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

## Detector Tree

The detector tree contains all components needed to measure the intensity and color of the DUTs under test. The primary detector is mounted at the centerline of the optical system, while the reflex detectors are mounted at the proper angular heights to report off-axis reflex as required.



## Computer and Software

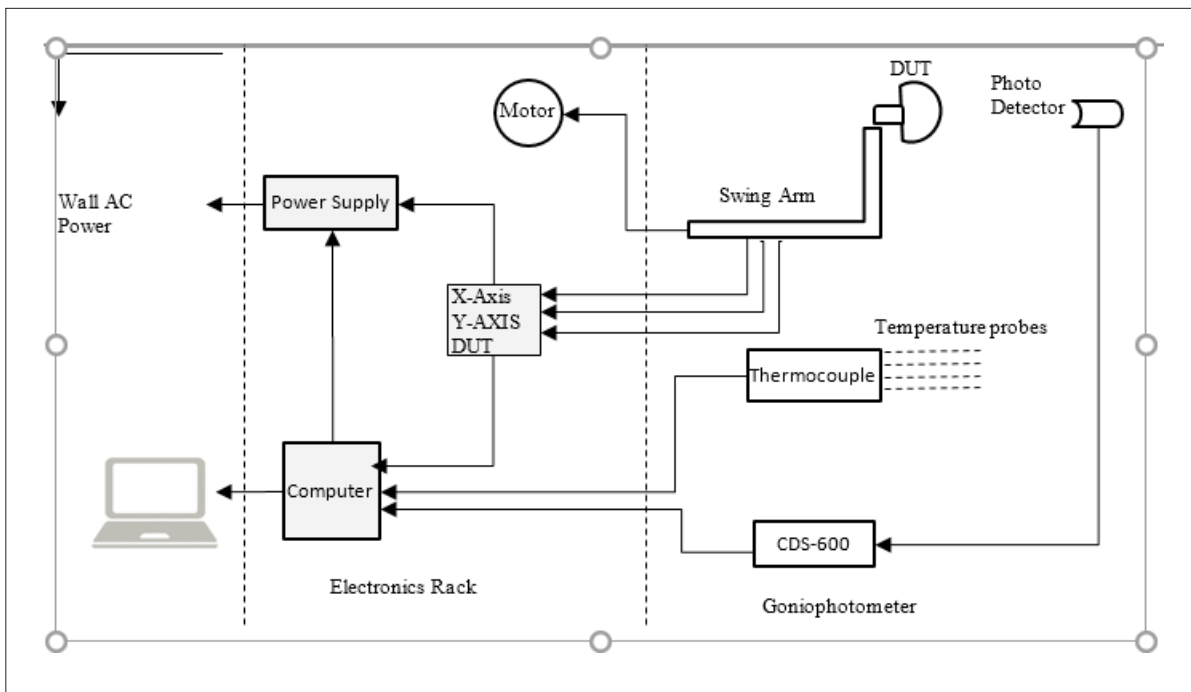
The functional heart of the Type A Goniometer is the computer hardware and software which control the system's entire operation. Virtually all functions of the system are computer automated including the vertical arm rotation, lamp/luminaire rotation, selection of data points and the recording of data.

The computer system provided with the Type A 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.

## 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.





## Photometric Measurement System

The photometric test equipment consists of an optometer and one or more detector heads (number of heads depends on options chosen.) The optometer is an 8 channel high precision light meter and measures all 8 channels independently with a wide dynamic range. It can be specified with standard 2 ms -10 ms slew rates, or for pulse measurement and high speed read on the fly. May optionally be configured with a 1 ms slew rate. Able to measure 10 decades of range while adjusting the integration time from 1 ms to 999s, measuring from 0.1 pA to 2 mA of signal in 12 bit resolution. Detector heads are custom machined, optically enhanced silicone detectors for high sensitivity to read ultra low light levels less than 1cd at 100' test distance with integral photopic filter. The high quality, Si-photodiode is carefully matched to the photometric DIN and CIE V(λ) nominal curve using a multilayer optical correction filter. The V(λ) matching of the luminous flux measurement head generally corresponds to the DIN-5032-T7 quality class B or better.

The measurement range of the optometer combined with the light detector is calculated by the measurement range specification of the optometer and the responsivity of the detector head as follows:

- Offset signal
  - = Maximum Resolution = meter current offset signal / detector sensitivity
  - Sample: 0.1 pA (0.1E - 12 A) / 3 nA/(mW/cm<sup>2</sup>) (irradiance detector) = 0.33 nW/cm<sup>2</sup>
- Minimum measurable irradiation
  - = offset signal \* signal to noise ratio factor
  - Sample: 0.33 nW/cm<sup>2</sup> \* 50 = 17 nW/cm<sup>2</sup>
- Maximum measurable irradiation \*
  - = max. signal current detector / detector sensitivity
  - Sample: 1 mA (10E - 3 A) / 3 nA/(mW/cm<sup>2</sup>) = 333333 W/cm<sup>2</sup>
- Display range
  - = Offset signal to maximum measurable signal
  - Sample: 0.33 nW/cm<sup>2</sup> to 333333 W/cm<sup>2</sup>
- Measurement range
  - = min measurable irradiation to maximum measurable irradiation
  - Sample: 17 nW/cm<sup>2</sup> to 333333 W/cm<sup>2</sup>

## Spectrometer Sensor (optional)

The sensor is the 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 A Goniometer it is used for the visible range of 380 to 780 nm. When coupled with a Type A Goniometer, the spectrometers avoid 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. 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 provide attenuation of high intensity lamps to prevent saturating of the sensors, increasing the sensitivity and dynamic range of the system.

The optical fiber sensor can be moved along the optical rail to change the distance between the sensor and the vertical rotation axis of the system. Industry recommendations for keeping in the far field for the goniometer is 5x the area of illumination. In most cases it is not necessary to move the sensor distance from its fixed position.

The spectrometer is calibrated for spectral intensity. The spectral intensity 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 goniometer detector tree structure. It is interfaced to the goniometer console computer via USB or Ethernet.

## Goniometer Console

This component contains all of the system's electrical and electronic controls. Main power switches and a test primary lamp voltage input, power analyzer and computer are included in the goniometer console.

### 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 it comes 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 Yokogawa WT 310E Power Analyzer are 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 it comes 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 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 are available.

## Control Software

Comprehensive software controls the operation of the Type A Goniometer and gathers the appropriate test data for the particular type of DUT being tested. Standard test formats for most automotive tests from SAE, ECE and JIS 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-A 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 option is included.) 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)
- CCT
- Chromaticity x and y
- Set and Actual Angles
- Sensor Saturations Levels
- Axial Plot
- Iso-candela Plot
- Birds Eye Plot

## IES Formats

Labsphere's software supports IES-A 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 DUTs is also available. Please request information. Standard size Type A can handle luminaires up to 1.2 m tall x .06 m wide and a weight up to 10 kg (greater weight 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 swing arm and horizontal shaft
- The vertical swing arm motor, temperature monitor, and spectrometer are enclosed in the base of the black framed Goniometer chassis
- A precision rotating vertical axis incorporating +/-180° rotation of the arm around the DUT emitting surface
- A precision rotating horizontal (lateral) axis incorporating +/-90° rotation fitted with a low profile lateral (horizontal) axis enclosed with black metal sheathing
- A horizontal framework holding a lateral shaft, onto which are attached plates for mounting of the DUT from above or below
- Means for adjusting the depth of the horizontal arm which holds the vertical shaft and DUT, using locking 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
- Optical density filter set
- Spectral intensity lamp standard and mounting fixture
- 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 (three, one on control rack and two on the goniometer base)

### 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 A. Description in Appendix.
Axis	V-plane axis automated, H-axis rotation automated
Operation	Fully automated save loading lamp samples and align process
Shipping Weight	~300 kg
Area Occupied by Goniometer	<1.7 m x 0.75 m x 1.5 m (control rack 0.56 m x 0.64 m x 2 m)
Sensor Distance	10 m to 33 m
Device Limit Size	1.2 m x 0.6 m
Spectrometer	Ocean Optics Flame
Max Lamp Weight	~51 kg (heavier 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
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)	0.01 to >1,000,000
Color Temperature	1000K to 10,000K +/-35K (with spectrometer option)
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
Angular Rotation	
Angular Resolution	0.01 degree /step
Report Inputs	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

- a) Date and testing agency
- b) Manufacturer's name and designation of product under test
- c) Lamp category
- d) Lamp or luminaire
- e) Ambient temperature
- f) Power factor
- g) THD
- h) Current
- i) Voltage
- j) Warm up
- k) Lumen
- l) Lamp characteristics 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 warmup intensity data
- q) Ambient temperature
- r) Orientation (burning position) of product during test
- s) Photometric method or instrument goniometer
- 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 tristimulus)
- 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, and \*.LDT

## Traceability (where applicable)

NIST

# Ordering Information and Optional Equipment

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

<b>PART NUMBER</b>	<b>DESCRIPTION</b>
AA-01305-000	<b>TYPE A GONIOMETER</b>

## **OPTIONS**

AA-01305-001	Reflex Single Angle
AA-01305-002	Reflex Three Angles
AA-01305-003	License Lamp
AA-01305-004	Thermocouple Integration
AA-01305-005	Color Measurement (Spectrometer)
AA-01305-006	Color Measurement (Tristimulus)
AA-01305-007	Pulsed measurement option for flashing light

## **INSTALLATIONS**

AA-01308-000	Installation – North America
AA-01308-001	International Installation – Western Europe
AA-01308-002	International Installation – Eastern Europe
AA-01308-003	International Installation – Latin America
AA-01308-004	International Installation – Africa South of Sahara
AA-01308-005	International Installation – North Africa, Southwest Asia
AA-01308-006	International Installation – Southern Asia
AA-01308-007	International Installation – Eastern Asia
AA-01308-008	International Installation – South Pacific

## **ACCESSORIES**

AA-01309-000	NIST Calibrated Sources
AA-01309-001	Remote Control and Monitoring (up to 3 machines)
AA-01309-002	Safety Light Curtain (May increase with room setup)
AA-01309-003	AC Power Supply

## **EXTENDED WARRANTIES**

AA-01310-000	Software (12 Months)	2% of Invoice
AA-01310-001	Parts Only (12 Months)	5% of Invoice
AA-01310-002	Parts and Labor (12 Months)	7% of Invoice
AA-01310-003	Part and Labor w/1 week service (12 months)	10% of Invoice
AA-01310-004	Software (24 Months)	3.5% of Invoice
AA-01310-005	Parts Only (24 Months)	9% of Invoice
AA-01310-006	Parts and Labor (24 Months)	13% of Invoice
AA-01310-007	Part and Labor w/1 week service (24 months)	18% of Invoice

## Extended Description of Optional Equipment

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

### Reflex Measurement (Single Axis and Three Axes)

Enable the capability to measure reflex reflectors, warning triangles or reflective materials. Includes a projector to create uniform light on test sample, one or three detectors and an illuminance detector head for measuring the projected beam illuminance.

### License Lamp

Enables the ability to measure luminance and color of license lamps. (customer supplied mounting fixture)

### Thermocouple Integration

Allows for measurement of ambient and 6 user applied thermal couple positions. Records automatically for testing, can be used to trigger stabilization and can be used in graphical monitoring tests. Type J, K or T thermocouples per user request.

### Color Measurement

Provides ability to measure color of lamps, measure color over angle and to create color IES files. Able to choose spectrometer or tristimulus option for color measurement. Tristimulus measurement uses an RGB detector for measurement of the illuminance and luminous color. The photometric responsivity and the cosine field of view function of the Y-detector correspond to the DIN 5032- Article 7 quality class B. Instead of the red, green and blue receptors found in the human eye, the detector is equipped with four photodiodes. Separation of the x function in x-short and x-long photodiode enables the detector to guarantee outstanding measurement results when combined with blue dominant light spectra.

### Pulse Measurement

Enables the ability to measure flashing lights to SAE requirements, conspicuity and anti-collision. Can measure aircraft or automotive flashing lights. Can handle random or fixed period flashing lights. More details for test algorithms available upon request.



### Remote Monitoring

Enables the user to view and operate software and machine movement from a remote location. Includes remote monitor, keyboard and mouse in addition to cameras and a monitor to view cameras. Allows for safe remote operation of equipment.

The Type A 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-75-01 Goniometer Types and Photometric Coordinates Automotive Test Specification

**Goniometer comes with the following applicable tests, others can be added as specified by customer.**

- SAE J1395, J2039, J914, (Backup, Tail, Stop, CHMSL, Side Marker, Fog, Headlamp, Position, Warning and Side Marker lamps)
- DOT C4, C3, C2 (Conspicuity testing)
- ECE 98, 113, 112, 23, 7, 6 (Backup, Tail, Stop, CHMSL, Side Marker, Fog, Headlamp, Position and Side Marker lamps)
- JIS (Motorcycle low and high beam)

# Sample Test Report

## Labsphere

Test number: 3,116  
 Date/Time: 7/18/2016 8:25:58 PM  
 Operator: Matt Sommers  
 Part number: 001  
 Sample number: 1  
 Cavity number: 2  
 Description: Stop Lamp (1 Lighted Section)  
 Specification: SAE J586 FEB84  
 Voltage: 6.1926  
 Current: 18.1956  
 Bulb type: 881  
 Orientation (H/V): H  
 Warm up time (min:sec): 0:00.0  
 Ambient temp: 30.6°C  
 This is a test report.

### Luminous Intensity, Candela

Test Points Degrees		Measured	Required Minimum Maximum	
10.00U	5.00L	912,240 Cd*	16	300
10.00U	5.00R	912,240 Cd*	16	300
5.00U	20.00L	977,385 Cd*	10	300
5.00U	10.00L	977,385 Cd*	30	300
5.00U	V	977,385 Cd*	70	300
5.00U	10.00R	977,384 Cd*	30	300
5.00U	20.00R	977,384 Cd*	10	300
H	10.00L	1,000,001 Cd*	40	300
H	5.00L	1,000,000 Cd*	80	300
H	V	1,000,001 Cd*	80	300
H	5.00R	1,000,001 Cd*	80	300
H	10.00R	1,000,000 Cd*	40	300
5.00D	20.00L	977,385 Cd*	10	300
5.00D	10.00L	977,385 Cd*	30	300
5.00D	V	977,384 Cd*	70	300
5.00D	10.00R	977,384 Cd*	30	300
5.00D	20.00R	977,384 Cd*	10	300
10.00D	5.00L	912,240 Cd*	16	300