* The 19” Cabinet shown in picture is for demonstration only and not included in system

LG-1.5

Rotating Luminaire Goniophotometer

Photometric Solutions International Pty Ltd
Factory Two, 21-29 Railway Ave, Huntingdale, Vic, 3166, Australia
Tel: +61 3 9568 1879 Fax: +61 3 9568 4667

ABN 34 106 665 141
Email: sales@photometricsolutions.com
www.photometricsolutions.com

Part 1. LG-1.5 Rotating Luminaire Goniophotometer

The LG-1.5 is a large version of the LG-1 series of rotating luminaire goniophotometers. It is a compact goniophotometer for luminaire manufacturers or institutions who do not have the space, budget or need for a large, swinging mirror-type goniophotometer. It comprises a floor-standing goniometer, a photometer and a software interface.

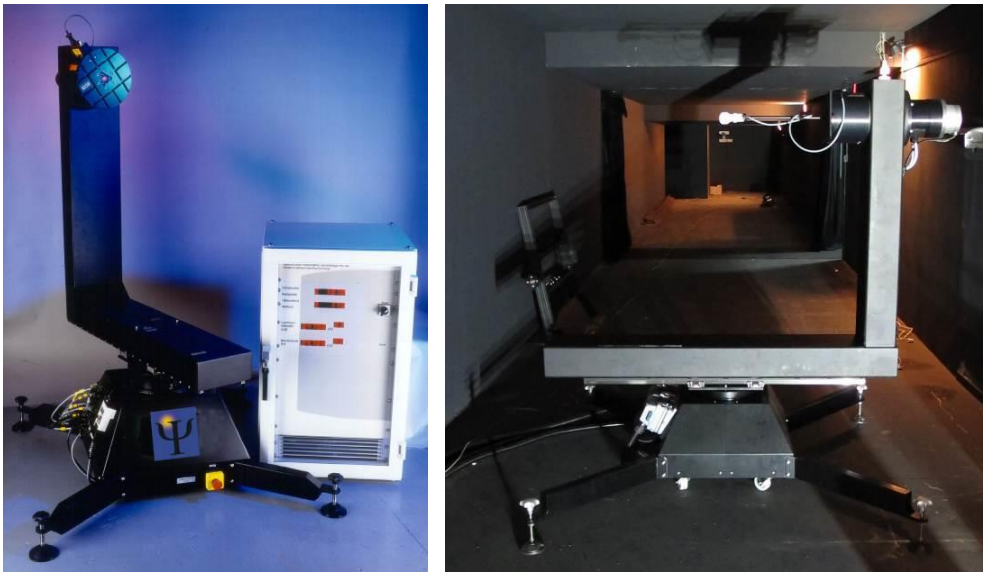

Figure 1: The LG-1.5: (Left) Shown with a 19" Cabinet and old PSI logo (Right) Shown in a dark room before stray light baffles are installed.

Theory of Operation

The sample is mounted on the goniometer and rotated around a pivot point through two axes of rotation. This presents the different orientations of the test item towards a detector, mounted at a distance across the room. Through this way the luminous intensity distribution of the test item is measured.

Windows-based software running on a PC coordinates the motion and the measurement, stores the data and produces professional reports.

This is a rotating luminaire goniophotometer and therefore the burning position of the lamp will change throughout the course of the test. It is therefore not ideal for measuring gravity-dependant light sources such as discharge lamps like HID and fluorescent lamps. However, it is perfect for measuring sources such as LEDs.

Goniometer

The goniometer is manufactured from aluminium and steel and is lightweight but robust. Once positioned and aligned it is fixed directly to the floor. An adjustable counterweight is used in the horizontal rotating section.

The vertical axis can rotate through 360 degrees (e.g. rotating in elevation angles from 0 to 180 degrees in a full C-plane pair such as 0°/180° full plane) and the horizontal axis can rotate continuously through more than 360 degrees (e.g. rotating in C-planes from 0 to 360 degrees) with a slip ring for the cables so that they don't get tangled. Both axes have better than 0.001-degree resolution and 0.1-degree angular accuracy.

The intersection of the horizontal and vertical axes is called the "pivot point" of the goniometer.

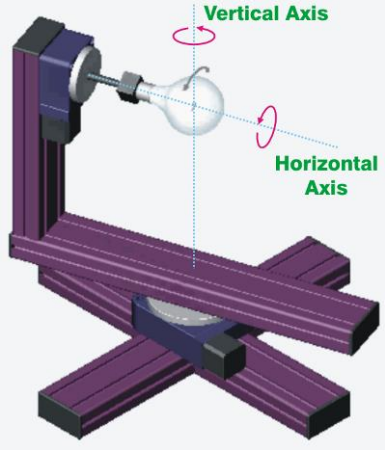

Figure 2: Schematic Diagram of the LG-1.5 Rotation Axes

The pivot point is approximately 1.5 metres above the floor level.

Motion is provided by high quality harmonic drives to maximise performance and minimise backlash.

Test Items

The **LG-1.5** goniometer can accept test items up to:

- 2000 mm in diameter, ie: the gap between the pivot point and the lower arm of the goniometer is around 1000 mm;
- 600 mm in depth, ie: the gap between the pivot point and the front face of the luminaire rotation table is more than 600 mm; and
- 50 kg mass, assuming that the mass is evenly distributed and the luminaire is reasonably balanced.

These specifications cater for practically all types of lamps, individual LEDs or LED clusters and a variety of small to medium sized luminaires. The key dimensions are shown in the diagram below.

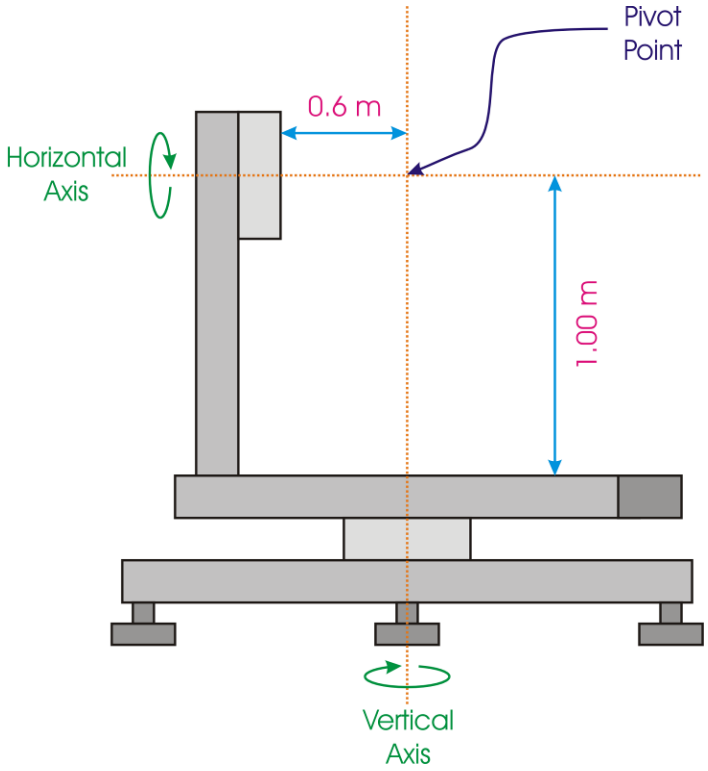

Figure 3: LG-1.5 Dimensions

With an Automotive Photometry software module added on (see Optional Extras), automotive signals such as brake lights, indicators, etc. can also be measured.

Test Item Mounting

When testing, the photometric reference point of the test item being measured is positioned at the pivot point of the goniometer. The vertical section on which the test item is mounted may be moved back and forth along the horizontal section to accommodate test items of different sizes.

At the top of the vertical section is a rotary stage, which has a table containing various drilled and tapped holes for attaching mounting brackets. There is a slip ring to provide power and voltage sense to the test item without tangling the cables.

Photometric Measurement System

The measurement system (photometer) consists of a photocell, photocurrent preamplifier and analogue-to-digital converter. The photocell is thermostatically controlled at 35 °C and has an 8 mm receptive area and a responsivity of around 14 nA/lx. The photocell has a V (lambda) response with f_1' < 1.50 % (Class L), which is consistent with CIE and ECE recommendations for photocells for measurement of automotive devices and signals, and is therefore suitable for LEDs and coloured signals.

The photocell is fed into a multi-ranging photocurrent preamplifier, with built-in analogue-to-digital conversion, that is controlled by the PC. Digital or software triggering from the motor controller to the data acquisition card means that fast sampling of test scans can be achieved. The amplifier has variable integration time so that it can measure all types of sources including DC and also pulse-width modulated (PWM) light sources.

The software includes a photometer integration time optimiser for determining the best integration time to use for PWM sources.

The photometer has an operating range from 10^{-5} lx up to 5 x 10^{4} lx. This corresponds to around 0.0001 cd at a test distance of 3.162 metres. An ISO-17025 certified calibration certificate with traceability is provided with the system.

Figure 4: Photocell and Amplifier

Baffle Tube

The photocell will be mounted in a baffle tube to block out any unwanted stray light from the walls, floor and ceiling. There are internal apertures inside the tube that prohibit reflections off the internal surface of the tube.

Each baffle tube is custom-made, based on the client's preferred test distance and maximum test item size.

Power Analyser with Software Interface

We will supply a Yokogawa WT310E power analyser for monitoring the mains operating parameters (voltage, current, power and power factor). The power analyser will be interfaced with the control software in the PC so that the electrical parameters are automatically saved with the test data.

Power Supplies

No power supplies are provided with the system, but a selection can be offered on request.

Correction Measurements

The LG-1.5 is a rotating luminaire goniophotometer. The test item is aimed towards the photocell and rotated; therefore it is not mounted in its designed burning position and does not maintain a constant attitude during the test. This can affect the measurement of lamps whose light output changes when they are tilted to different angles, such as most types of discharge lamps.

Furthermore, for LED luminaires, the different mounting position (and therefore different air flow characteristics) may cause the luminaire to settle at a different temperature, which can affect the luminous output.

To correct for these effects we offer a Lamp/Luminaire Attitude Device (LLAD) – see optional extras.

Auxiliary Display of Test Information

Figure 1 near the start of the quote shows the LG-1.5 with a 19" Rack Cabinet and LED digital displays. However we now offer the LG-1.5 with a secondary monitor as the auxiliary display instead of the LED digital displays.

The Auxiliary Display of the test information has a twofold purpose – it looks good and gives the laboratory a professional feel, and also it is used by the operator while aiming the test item – it can be used, for example, to locate the beam maximum position of a floodlight. The information shown on the Auxiliary Display includes the C-Plane Angle and Elevation Angle (or Horizontal Angle and Vertical Angle), plus the Luminous Intensity and Illuminance.

The Auxiliary display consists of a large flatscreen monitor, which can be mounted in a rack next to the PC or on one of the laboratory walls. This monitor operates separately to the main PC monitor. The monitor will be positioned so that it can be seen by the operator while sitting at the desk and also when aligning the luminaire, but it will be placed so that it is not within the view of the photocell.

When using the remote hand-held controller for aligning the test item or profiling a floodlight beam, the Auxiliary display displays a graph of the luminous intensity vs time, so that it is very easy to locate the beam maximum.

Figure 5: Secondary Monitor

Software

The software that comes with the system is in two parts: control software to operate the equipment and report generation software to produce printed output. The big advantage of dividing the software into these two categories is that the report generation software can be installed onto other PCs so that reports can be produced while other measurements are being performed.

The control software that comes with the LG-1.5 is capable of performing measurements of luminous flux and also luminous intensity distribution.

When the software initialises, it checks all devices attached to the system to check that they are working properly. In the event of a failure or misbehaviour of one or more of the devices, an error message should be shown indicating which device is not functioning correctly and the most probable cause of the problem.

The control software has the flexibility to give the operator all of the control that he needs, and is not restrictive and rigid. Features include:

- Ability to specify test angles and angular increments;
- Ability to take measurements “on the fly” without stopping;
- Bare lamp luminous flux measurement or luminous intensity distribution measurement or both;
- Facility for monitoring the stability of test items;
- Joystick control for arbitrary rotations of goniometer axes;
    - Ability to select from two coordinate systems, ie:
- Type C/γ for luminaires;
- Type B/β for floodlights;
    - Ability to set multiple calibrations, which are then selected according to lamp type (required for highest accuracy measurement);
    - Stray light subtraction, by measuring a single stray light value and then subtracting this from all measured data.

Some screen captures of the control software are shown below and on the following pages.

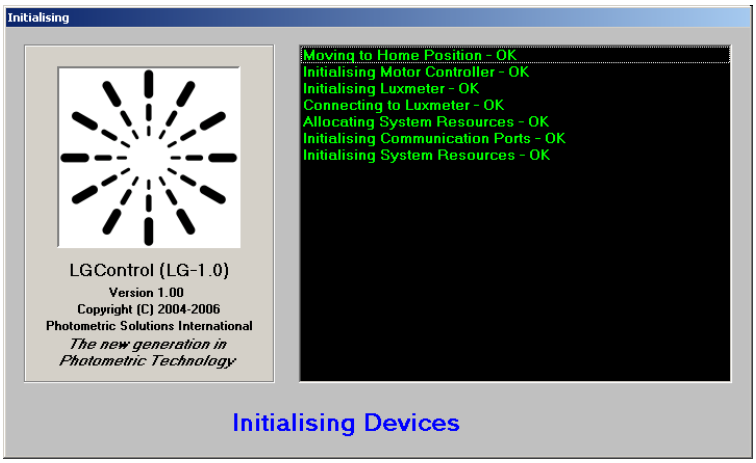

Figure 6: Initialising Devices

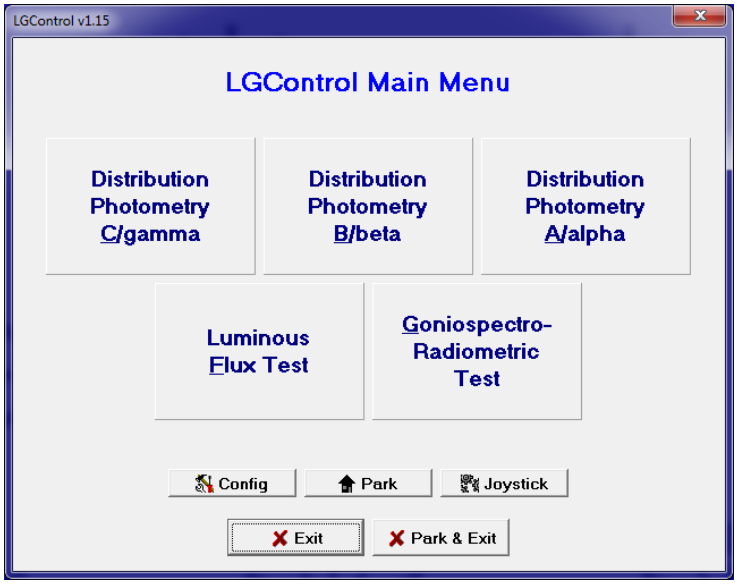

Figure 7: Main Menu

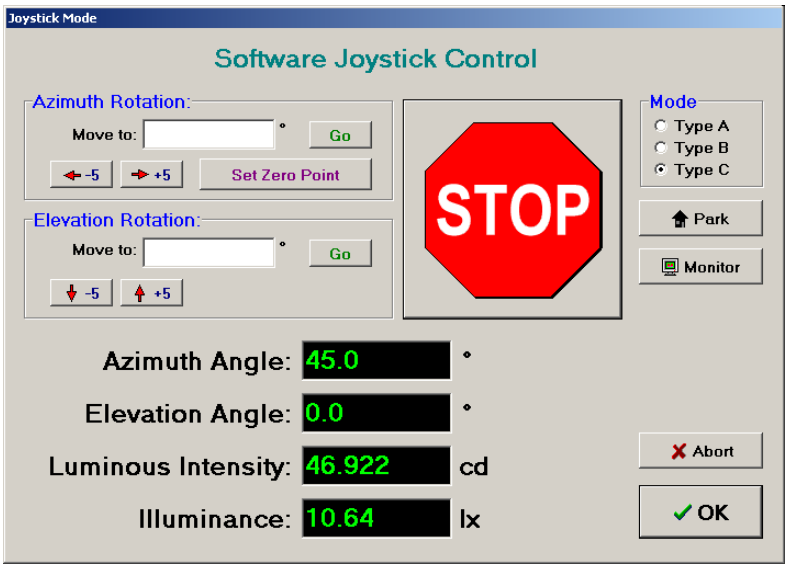

Figure 8: Joystick Control for Arbitrary Control of the Goniometer

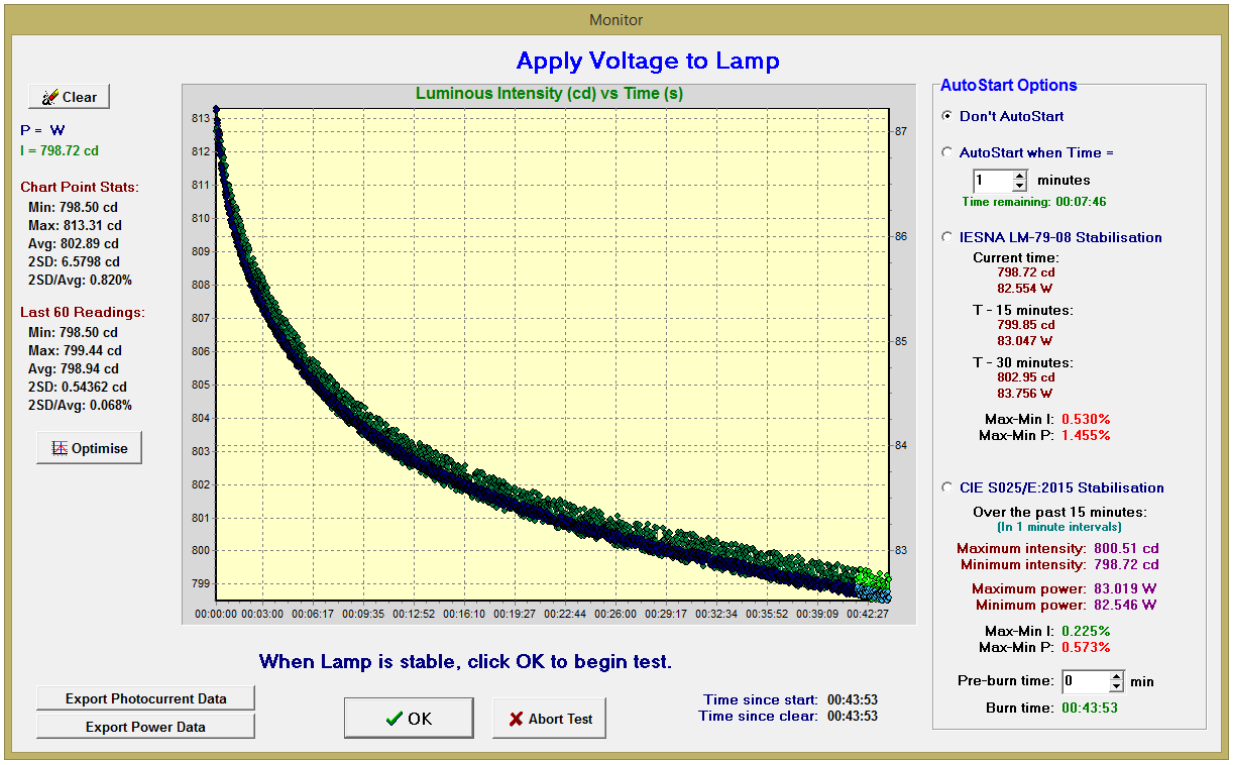

Figure 9: Photocell Monitor Window for Determining Test Item Stabilisation, including stabilisation conditions for CIE S 025/E:2015 and IESNA LM-79-08

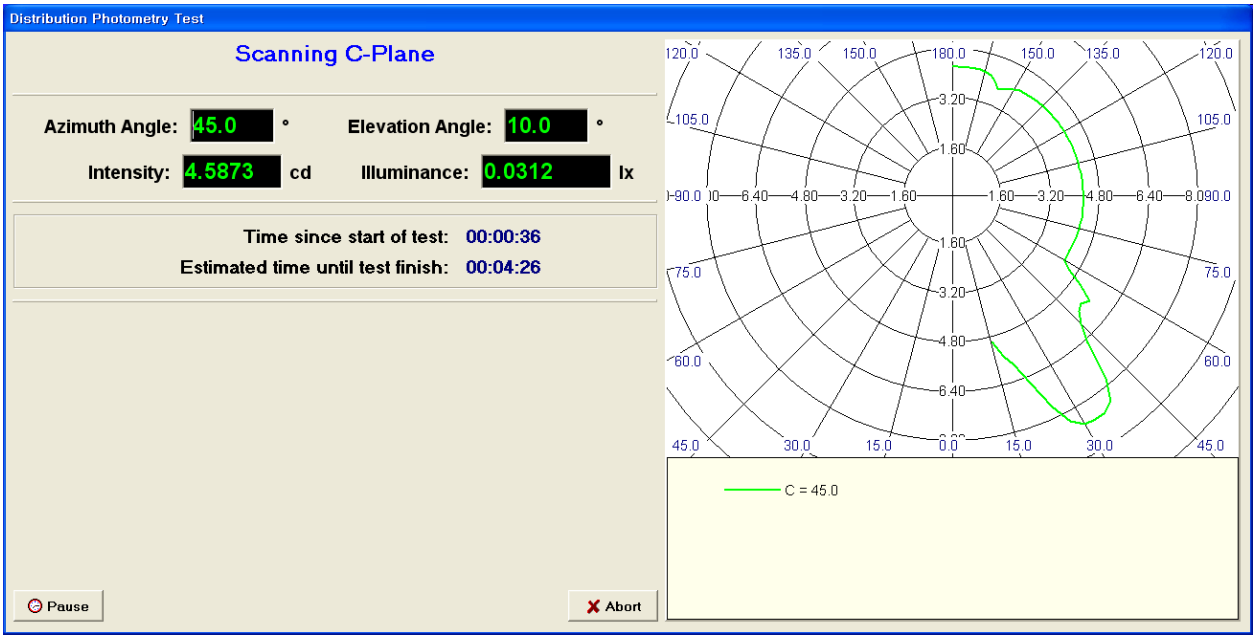

Figure 10: Polar curve shown real-time while performing a Type C Test

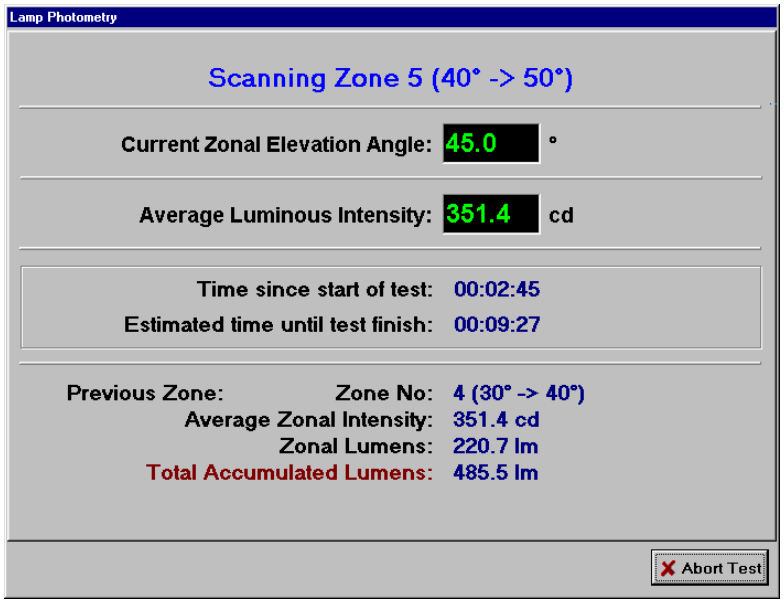

Figure 11: Bare Lamp or LED Luminous Flux Test

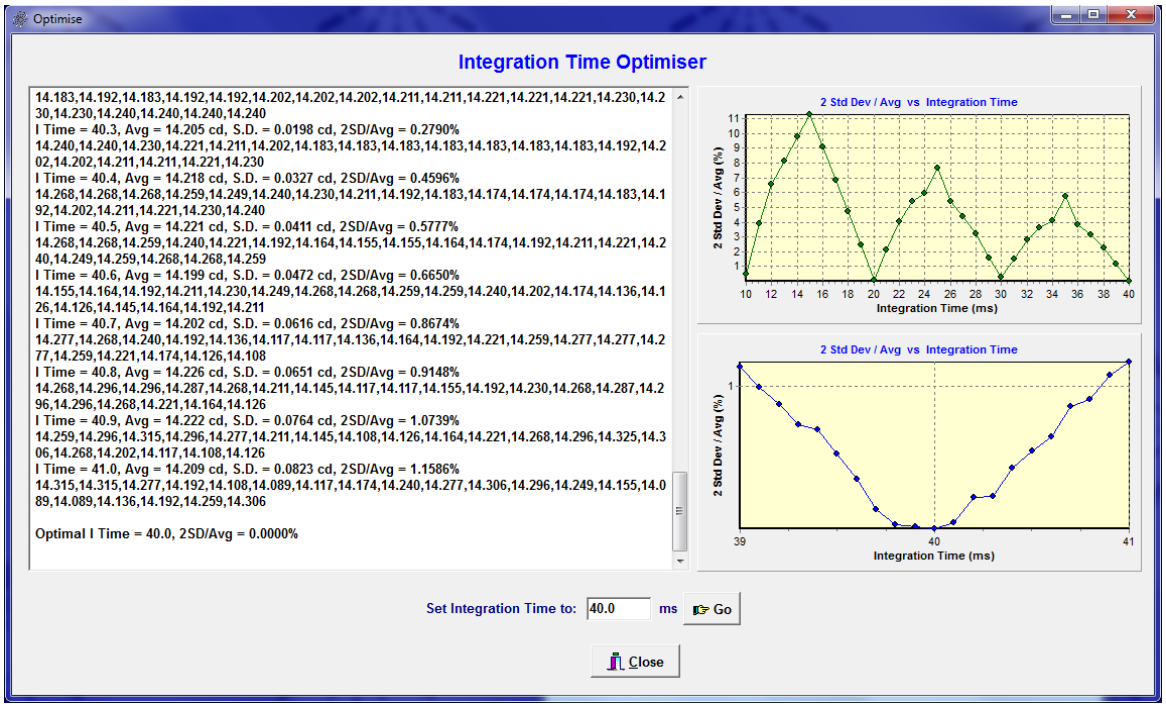

Figure 12: Photometer integration time optimiser for determining the best integration time to use for PWM sources

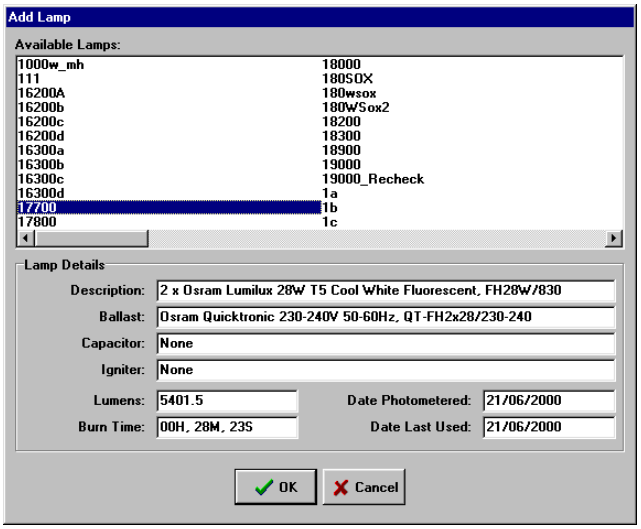

Figure 13: Standard Lamp Library

The report generation software is also flexible. The user can select which pages are to be included in a report so that the report may be customised according to each client's needs. Fixed report generators that have a standard format for each type of test item are too restrictive.

Features of our report generation software for measurements of luminous intensity distribution include:

- Ability to customise the contact details and logo that appear on the printed pages;
- Test details with uncertainties of measurement;
- Polar curves and H-V plots – with ability to zoom in on lowest 10% regions to study spill-light;
- IsoCandela diagrams – Azimuthal projection format and H-V format;
- IsoLux diagrams – basic types only are needed here as there are many types of professional lighting-layout software available;
- 3D Web format for both the IsoLux and IsoCandela diagrams;
- Luminous flux summary table;
- Zonal flux diagram;
- Ability to display a digital image of the test item in the report for easy identification;

The IsoLux, IsoCandela and 3D Web format diagrams have options for line contour or shading formats, and the user can specify the values of the contours.

Further information is in our other quote for our PhotometricSuite software. Please note that one licence of this software is provided free of charge with the goniophotometer system.

PC

The client is to provide a PC based on PSI's recommendations. We generally find that most problems encountered are PC-related so we prefer that this is supplied locally for local servicing.

The building arrangements are the responsibility of the client. This includes:

- Laboratory construction;
- Painting of room surfaces, where appropriate, a matt black colour;
- Construction of stray light baffles and curtains, where appropriate;
- Dust-proofing and air conditioning.

The room, or the space within the room which is dedicated to the LG-1.5 system, should be at least 4m wide and 2m longer than the test distance. The test distance should be at least 15 times longer than the largest dimension of the test item being measured. For example, to measure test items up to 1.0 metres in diameter we recommend a test distance of at least 15 metres, while to measure test items up to 1.5 metres in diameter we recommend a test distance of 22.5 metres.

Stray light baffles such as wooden panels or curtains should be placed on the walls, floor and ceiling. PSI staff can advise the client of the requirements for the baffles in advance or at the time of installation.

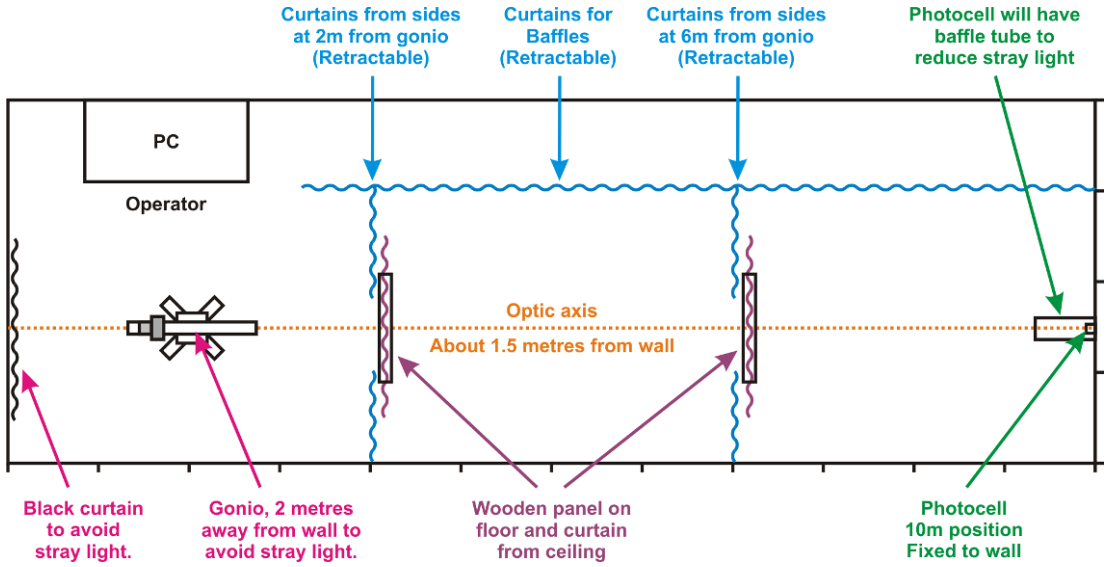

Figure 14: Sample Layout for a room 12 x 4 metres

Figure 15: Curtains and wooden panels for baffling

The entire room or area should be light-tight and dust-proof. The room needs to be maintained at 25 degrees Celsius and preferably around 50-70% humidity.

Mains supply should be properly earthed, stabilised and filtered. The mains electrical supply for the entire system should be provided through an uninterruptible power supply (UPS) system, or at the very least through a voltage stabiliser, and should include an isolation transformer and line filter. PSI can advise the client regarding the best locations of power outlets.

PSI will professionally pack the equipment in solid wooden crates.

Shipping Terms

FCA Melbourne

Documentation

The equipment and software provided comes with a User Manual (in English) which details the procedures for measuring lamp luminous flux and luminous intensity distributions with the LG-1.5 system in easy to follow instructions. The manual also contains connection diagrams and troubleshooting guides to the various components of the system.

Installation and Training

Installation and one day's on-site training is included in the price.

Warranty

PSI provides an unconditional warranty on all of the photometric equipment supplied for 12 months from the date of final acceptance, or according to the limitations of the warranty of the manufacturer of any individual component. During the warranty period, PSI will repair or replace any faulty equipment at no charge to the client. The client is responsible for fixing hardware failures in the PC system, however PSI will actively assist the client in determining the nature of and resolving any such problem that may occur.

This warranty does not cover misuse, abuse or accidental damage to the equipment. In such a case all repairs and travel and accommodation expenses will be born by the Client.

Part 2. Optional Extras

Lamp/Luminaire Attitude Device (LLAD)

The LG-1.5 is a rotating luminaire goniophotometer. The test item is aimed towards the photocell and rotated; therefore it is not mounted in its designed burning position and does not maintain a constant attitude during the test. This can affect the measurement of lamps whose light output changes when they are tilted to different angles, such as most types of discharge lamps.

Furthermore, for LED luminaires, the different mounting position (and therefore different air flow characteristics) may cause the luminaire to settle at a different temperature, which can affect the luminous output.

To correct for these effects we use a Lamp/Luminaire Attitude Device (LLAD).

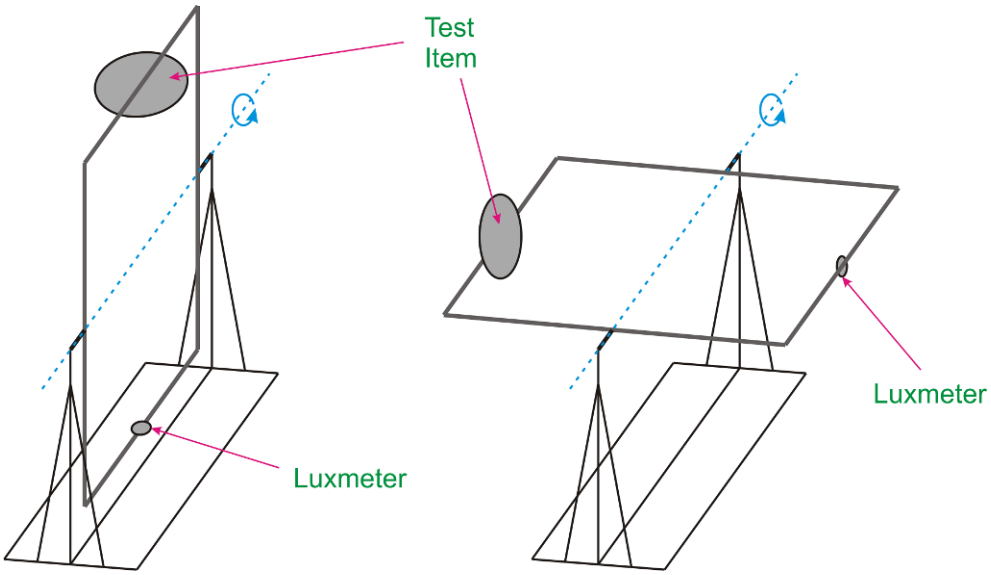

Figure 16: Lamp/Luminaire Attitude Device (LLAD)

The LLAD consists of a cradle with a frame that can be rotated about a horizontal axis. It has a mounting bracket onto which the test item can be attached and a luxmeter with a detector that is in a fixed position with respect to the mounting bracket. Thus, the luxmeter's detector has the same view of the test item regardless of the angle to which the frame is rotated.

The test item is mounted on the LLAD and the frame rotated so that the test item is in its designed burning position, e.g. aiming directly downwards (see Figure 16, left). The test item is then switched on and allowed to fully stabilise. The luxmeter then takes a measurement.

The frame is then tilted in the cradle so that the detector is in the horizontal position (see Figure 16, right). This is now equivalent to the measurement condition when the test item is mounted on the goniophotometer. The test item is allowed to stabilise again and luxmeter then takes a second measurement.

The luxmeter has now taken two measurements: one with the test item in its designed burning position and one with the test item in the orientation that it will be mounted on the goniophotometer. These two measurements can be used to correct the measurements made on the goniophotometer to the performance of the luminaire in its designed burning position.

The scope of supply this optional extra is as follows:

- LLAD cradle and frame;
- Luxmeter with remote detector head;
- Software to perform the measurement and calculate the correction.

Type B Adapter

This option is for a bracket with support and bearing to mount on the goniometer to hold luminaires in the sideways position for testing to Type B/β geometry. This is important for floodlight luminaires. It can accept luminaires up to 1.1 x 1.1 metres and 50 kg, although performance will also be limited by the moment of force that the luminaire exhibits.

The Type B Adapter is shown in Figure 17 below.

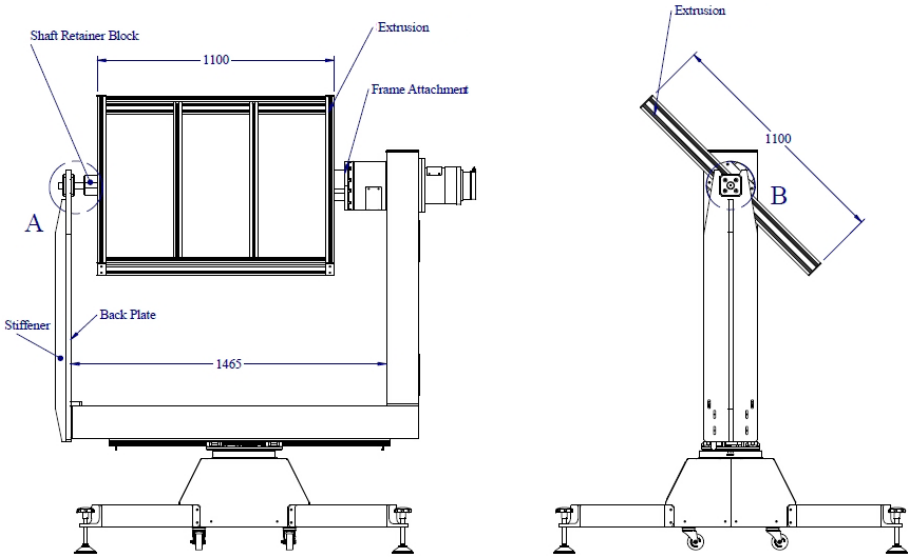

Figure 17: Type B Adapter

Photometer Calibration by NMIA

The photometer comes standard with a calibration certificate from PSI's in-house ISO-17025 accredited laboratory. For some photometric laboratories, however, a higher accuracy (lower uncertainty) calibration may be preferable. This option provides for a calibration by Australia's National Measurement Institute.

Please note that this option increases the delivery time by approximately 4-6 weeks.

SP-3C Spectroradiometer

We will include our SP-3C spectroradiometer for measurement of chromaticity (colour) of the test items. The SP-3C is a real-time colour measurement system. It features optic fibre input and entrance optics, including filter wheel, a spectral measurement chamber and an embedded PC to coordinate the acquisition. This is shown in Figure 18 to Figure 20 below.

Figure 18: SP-3C Perspective Views

Figure 19: SP-3C in a Typical Laboratory Setup

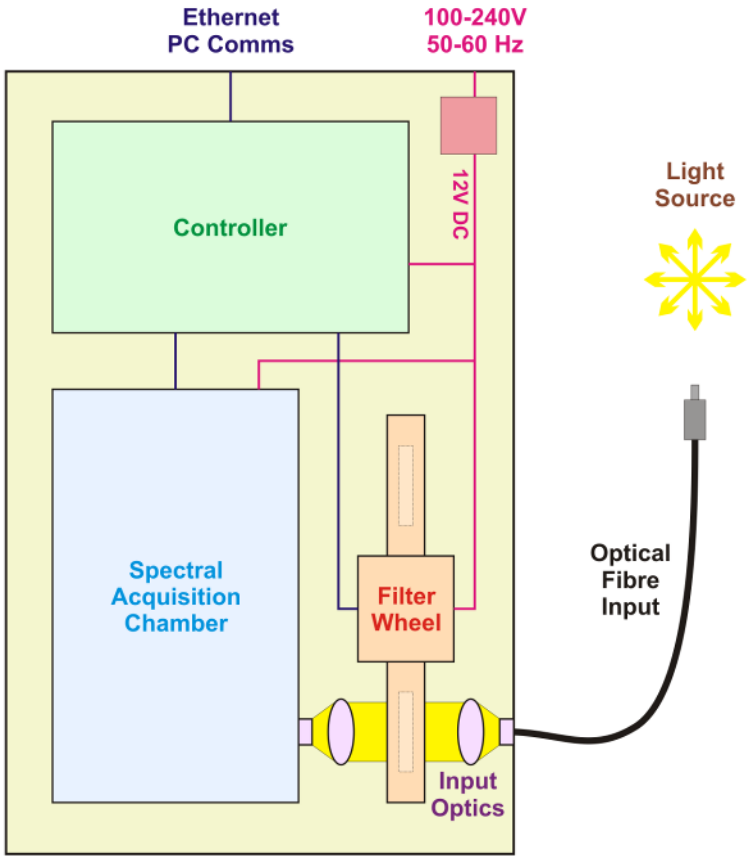

Figure 20: Schematic Diagram of the SP-3C

The spectral acquisition chamber features a single diffraction grating and CCD array arrangement, so that the entire spectrum is acquired in a single scan of the CCD array. Because the entrance slit, alignment optics, grating and CCD array are all in fixed positions, there are no moving parts and no further wavelength calibrations are required once it leaves the factory.

There is a filter wheel positioned in the input optics. The filter wheel contains a set of neutral density filters to reduce the signal for strong light sources, plus also a blocking filter for dark measurements.

The optical fibre input of the SP-3C will be mounted next to the photocell at the back of the laboratory on a rotating table so that the fibre can follow the mirror as it swings up and down. The software will be modified so that the operator can perform gonio-spectroradiometric measurements according to CIE S 025/E:2015 and IESNA LM-79-08, and calculations including:

- Chromaticity coordinates (x, y) and (u', v');
- Correlated colour temperature (CCT) and D_{uv};
- Colour rendering index R_a.

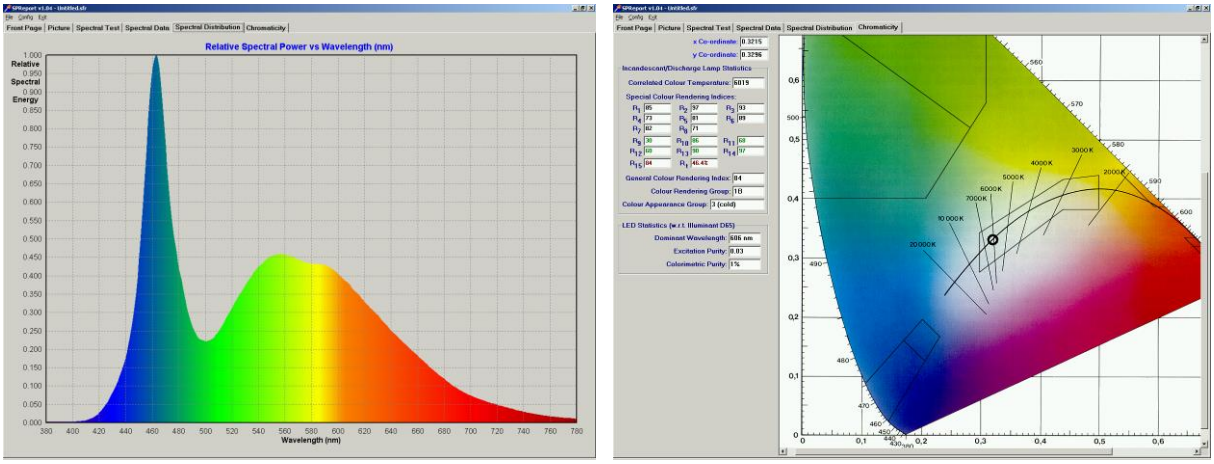

Figure 21: Typical Output from the SP-3C

Flux Integrator Add-on

We will supply an add-on to the LG-1.5 for absolute measurement of luminous flux of lamps and small luminaires. This consists of a frame and an additional motorised axis with software interface.

A bracket is provided to hold a lamp or small luminaire at the reference position of the goniometer (the intersection between the horizontal and vertical axes). Lamps up to 3 kg and 120 mm can be measured. One E27 holder is provided. The bracket has adjustable height and can be oriented in base up or base down position.

The motor that drives the lamp will be a servo motor with better than 0.01° resolution and 0.1° accuracy. The arm has adjustment so that the axis can be aligned vertically in any loading.

A bracket is also provided to mount the photometer head that comes with the LG-1.5 system within the plane coincident with the vertical axis and normal to the horizontal axis of the goniometer. The reference plane of the photometer head will have a radius of rotation of approximately 900 mm.

Figure 22: LG-1.5 with Flux Integrator Add-on