

T5 Goniophotometer with Rotating Mirror

T5 + is a highly accurate and reliable automatic mirror rotation goniometer for performing:

- ▶ photometric measurements of the distribution of light intensities and
- ▶ spectrometric measurements of color characteristics of conventional and LED lighting sources and luminaires.

The system is based on the latest generation robotic technology with the advantage of movements without chains or belts.

This technology, together with extremely high precision encoders and zero-backlash reducers, guarantees perfect positioning and imperceptible vibrations.

T5 + is made in compliance with the following standards and recommendations:

- ▶ CIE 70 Chapter 7
- ▶ EN 13032 Type 3.2
- ▶ IESNA LM-75 Type C (complying measurements according to IESNA LM-79)

T5+ allows measurement according to the following systems:

- ▶ C- γ
- ▶ or on conical surfaces.

Function Theory

T5+ allows measurement of luminaires and lighting sources in their normal functioning positions.

The luminaire is rotated around its own luminous axis, which corresponds with the vertical rotation axis of the machine, and keeps its position constant along the X and Y axis.

The mirror is rotated around the luminaire-photosensor axis and it is tilted to reflect the image of the luminaire directly towards the sensor (photocell) of the luxmeter or spectroradiometer.

The photosensors are properly shielded by a rotating panel synchronized with the mirror with a hole in it which is constantly centered on the center of the photosensor-mirror axis, thus reducing stray light to the minimum.

Characteristics

Mechanical Parts

The mechanical part consists of a support structure on which is mounted the shaft-reducer-motor system for movement of the mirror and the luminaire holder arm.

The main arm is fitted on the horizontal axis shaft which on one side features the counterweight and the mirror on the other. The spectroradiometer can be fitted near the counterweight.

The luminaire is mounted on the corresponding anchorage plate fitted with vertical lift system for an accurate vertical positioning of the luminaire during measurement.



Mirror Goniophotometer T5+



Synthesis of mechanical characteristics

▶ Machine (version with 2000 mm mirror)	
■ max. dimension (AxBxH)	2735x2930x7200 mm
■ max. total weight	3.000 kg approx.
■ max. rotation axis height	3400 mm +- 50 mm
■ axis rotation angle	- +360° (horizontal) + - 360° (vertical)
■ max. axis rotation speed	1 rpm
■ max. structure divergence	0.05°
■ max. structure vibrations	0.1° with freq. ≤10 Hz
■ axis perpendicularity error	0.01°
■ axes intersection error	1 mm
▶ Luminaire or Lamp	
■ max. diagonal	2000 mm
■ max. depth	600 mm
■ max. weight	50 kg

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During assembly, the vertical rotation axis must coincide with the optical axis of the luminaire in case of C- γ measurements.

The mechanical parts of the machine are coated with very low reflectance black paint.

Electromechanical Actuators / Motors

The system is operated by 4 motors:

- ▶ brushless motor with absolute encoder on board for the movement of the horizontal axis (rotation axis around which the mirror revolves) for the measurement of γ - or H- angles. In any case a second absolute encoder is mounted on the final axis as part of the outer feedback loop, which prevails over the inner retro activation of the brushless motor
- ▶ step-by-step motor, retro activated by an absolute encoder, for moving the luminaire around its optical axis, which coincides with the vertical axis, for the management of C- or V- semiplanes
- ▶ asynchronous motor, controlled by an inverter to guarantee the smooth vertical movement of the luminaire for an accurate positioning
- ▶ step-by-step motor retro activated by an absolute encoder for the movement of the rotating shield placed opposite the photosensor to ensure the exclusive vision of the mirror.

The motors can be operated separately by means of the special acceleration and deceleration ramps designed to restrict vibrations, or simultaneously with a touch-pad manual control system, equipped with emergency switch, or directly from the computer.

The system can measure in continuous movement or by stopping the machine in each measurement position C- γ or V-H: in the latter case the program proceeds to acquire at least 3 values whose difference must not exceed a pre-established range. If this is not the case, a further three values are taken and then compared until measurement stability is achieved. Measurement with machine stop in each measurement position is generally more precise than continuous measurement but slower.

Feed and Control Panel

The operation and control panel, mounted on the side of the machine, contains the motor circuit boards and all the electrical and safety components to feed and manage the machine.

The control panel must be fed with 3 separate lines having the following characteristics:

- ▶ Machine Feed Line: Voltage 230 V - Frequency 50 Hz - Max. power 2000 W - Peak Current 7 A (other feeds on request)
- ▶ Lamp Feed Line: Voltage 230 V or 380 V - Frequency 50 Hz - Max. power 5000 W - Peak Current: depends on feeder
- ▶ Computer and Devices Feed Line: Voltage 230 V - Frequency 50 Hz - Max. power 300 W (it is preferable to have a dedicated line).

Angle Measurement

The perfect positioning with respect to the C- semiplanes and the γ - angles is guaranteed by absolute encoders placed on the horizontal and vertical rotation axis.

The angular resolution of the encoders is equal to $4/100^\circ$ (13 bit) and the angular positions are shown on screen during measurement along with indication of the state of progress of measurement and the polar diagram of the plane under examination.

Luxmeter

The photocell consists of a silicon photovoltaic cell whose response corresponds to the relative visibility curve CIE $V(\lambda)$ using the full-filtering method.



The photocell is thermostated at 35°C and is supplied complete with a support to be fixed to the floor or ceiling. The support is equipped with all fine regulating systems for the various alignments and lasers to verify the centering of the luminaire/lamp.

Photocell – Luxmeter System Characteristics (In accordance with EN 13032 - CIE 69 - DIN 5032/6)

▶ Acquisition Area Diameter	8 mm
▶ Calibration Error u_{cal}	< 1%
▶ Correspondence to $V(\lambda)$ F_1 Curve	< 1,5%
▶ Directional Response Error f_2	< 1%
▶ Linearity Error f_3	< 0,1%
▶ Display Unit Error f_4	< 0,1%
▶ Fatigue f_5 (measured at 1 klx)	< 0,1%
▶ Modulated Light f_7	< 0,1%
▶ Polarization f_8	< 1%
▶ Scale Change Error f_{11}	< 0,1%
▶ Temperature Coefficient α_{25}	0,1%/K (L)-0,2%/K (A)
▶ Sensitivity to UV (u)	< 0,01%
▶ Sensitivity to IR (r)	< 0,01%
▶ Overall Characteristic f_{ges}	< 3%
▶ Integration Period at 50 Hz	20-200 ms
▶ Calibration Period	2 years

The photocell is connected to the luxmeter by a shielded cable of a maximum length of 70 m: should it be necessary to increase this distance, a suitable signal amplifier will have to be taken into consideration.

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Spectroradiometer (Optional)

The system can be equipped with an spectroradiometer fitted on the arm opposite the one that supports the mirror and pointed towards the luminaire to be measured.



It is therefore possible to make measurements as prescribed by the Standards IESNA LM-79 and EN 13032-4 by using the module Gonwin SP in Gonwin and defining a number n of C- semiplanes in which to make the measurements.

Spectroradiometer Characteristics

▶ Spectral Range	380-780 nm
▶ Optical Bandwidth	4,5 nm FWHM
▶ Wavelengths Resolution	1 nm
▶ Digital Resolution	15 bit ADC
▶ Dispersive Element	Imaging grating
▶ Sensor Type	Photodiode array
▶ Measuring Ranges	Luminance 1 150.000 cd/m2 Illuminance 1 ... 250 klx
▶ Photometric Accuracy	5 % (@ 2856 K)
▶ Chromaticity Accuracy	0.002 x, y (@ 2856 K)
▶ Color Repeatability	0.0005 x, y
▶ CCT Repeatability	+/-20 K (@ 2856 K)
▶ Wavelengths Accuracy	± 0.5 nm
▶ Calibration Traceability	NIST

Control and Data Acquisition System

The control unit organizes and manages the measurement and is connected to the computer by means of a TCP/IP interface.

The system manages all the measurement procedures, from reading angular positions to that of the signal from the photocell; it allows the angles to be fixed for a defined position and to carry out the whole measurement according to the C-Gamma, V-H systems or for conical surfaces.

Mirror

The mirror has high optical characteristics and is aluminized behind the glass to permit easy cleaning. It is in fact advisable to carry out frequent cleaning to maintain the reflecting capacity of the mirror intact.

The mirror is mounted on a rigid honeycomb aluminum support able to withstand distortions.

Characteristics

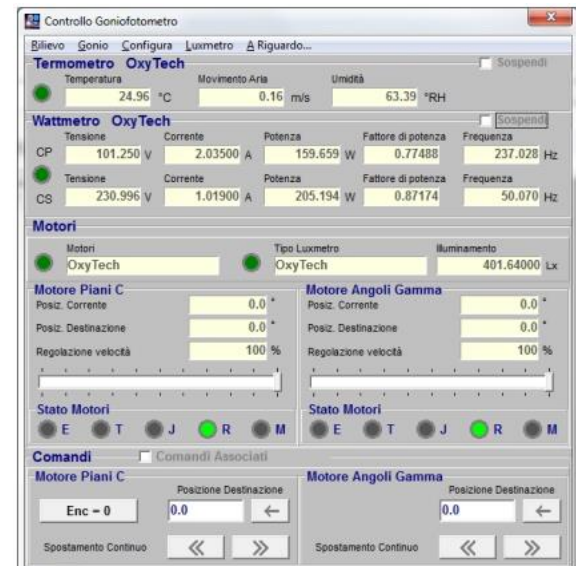
▶ Divergence	contained within 0,5°
▶ Global Reflection	uniform and contained within 0,5 %
▶ Spectral Reflection	uniform and contained within 0,5 %

Software - LITESTAR 4D Gonwin

The machine is supplied with management software **LITESTAR 4D Gonwin** in MS Windows® 10 environment that allows you to:



- ▶ carry out a complete measurement in accordance with:
 - standards (CIE Recommendations, EN Norm 13032 and Norm LM-79)
 - matrices freely set by the user.



- ▶ save the measured values in matrices in GF format (goniophotometer format) convertible into formats Eulumdat, IES, Cibse TM14, LTLI and OXL OxyTech with LITESTAR 4D Photoview.
- ▶ perform point measurements defined by the operator
- ▶ define the type of measurement whether continuous or with stops in every measurement position
- ▶ regulate the automatic start of measurement by evaluation of the full performance of the lamp
- ▶ regulate the length of the stops between one plane and the other

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- ▶ regulate the speed of rotation around the axes during measurement
- ▶ measure and save in Excel files:
 - the electrical parameters before and after the feeders (optional module)
 - the parameters of temperature, humidity and air speed (optional module)
- ▶ manage all functions of control and acquisition of measured and calculated values
- ▶ assess the lamp flux stability during measurement with immediate stop to the latter should the differences be greater than a predefined delta
- ▶ assess the stability of the electrical parameters during measurement with immediate stop of the latter should the differences be greater than a predefined delta
- ▶ assess the flux decay for emergency lighting devices in accordance with EN 1838 (optional module)
- ▶ visualize the stability graph of the electrical parameters throughout measurement
- ▶ visualize the polar diagram of the plane under examination throughout measurement
- ▶ automatically turn off lamp and machine at the end of measurement (useful function for long term measurements that can also be performed during the night) (optional module)
- ▶ measure the temperatures of luminaires and lamps using the thermocouple system (optional module).

The software works on PC in MS Windows® 10 environment and is available in more than 25 languages.

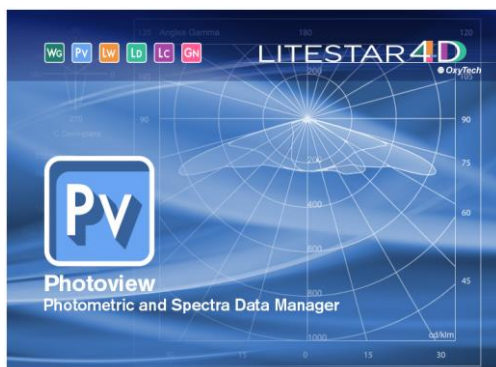
Optional Accessory Elements

The following optional accessory elements are available:

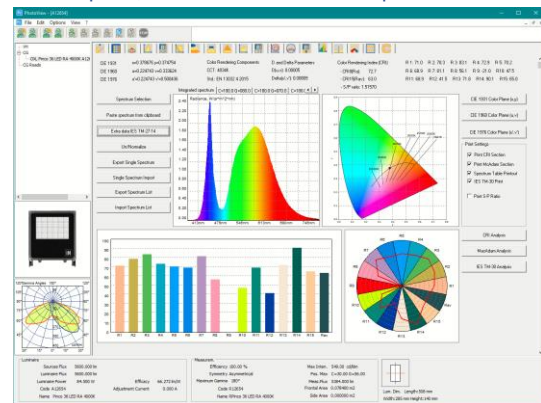
- ▶ Standard calibrated lamp for calibrating the goniophotometer inclusive of lampholder (4 wire technique), CC feeder and certificate
- ▶ Wave generator (power source)
- ▶ High precision multimeter with 1, 2 or 3 channels
- ▶ Special brackets for fixing luminaires and lamps.

Software - LITESTAR 4D Photoview

Processing and visualization of measurement results in tables and graphs are carried out with the **LITESTAR 4D Photoview Plus** module that allows you to:



- ▶ import the measurement data saving them in files defined by the operator
- ▶ convert a C- γ measurement into V-H and viceversa
- ▶ import and export the measurements in the standard formats Eulumdat, IES (86, 91 and 95), TM14, LTLI and OXL
- ▶ process graphs:
 - polar, Cartesian and of beam aperture



- of the glare
- of the isolux and isocandle curves
- of the yield for interior and road luminaires
- of the photometric classification of road luminaires according to IES TM-15 standard
- of the decay in emergency
- ▶ process the tables:
 - of the utilances and utilization factors
 - of UGR and luminance values
 - of the international classifications.

The software works on PC in MS Windows® 10 environment and is available in more than 25 languages.

Computer

The computer supplied with the machine complies with the following minimum requirements:

- ▶ PC with 1 Gb RAM or greater and 2 Gb hard disk
- ▶ 1 LAN and 2 USB interfaces
- ▶ color monitor
- ▶ MS Windows® 10 operating system or higher

Room Dimensions and Characteristics

Dimensions

The dimensions of the room in which to install the goniophotometer depend on the type of luminaire to be measured.

The distance photocell/luminous center of luminaire is determined according to the prescriptions given, for example, in standard EN13201-4:2015 paragraph 4.5.4.1.

Example: luminaire for linear 58W fluorescent lamps – dimension of luminous area approx. 1500 mm therefore the

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distance must not be less than 7.5 m. (in this case we may apply the rule of the 5 times the greatest dimension of the luminous area).

It is normally preferable to consider a distance of no less than 5 m even with luminaires of smaller dimensions.

It is also important to consider the type of beam emitted by the luminaire and the lamp power; in fact, when this is highly concentrated and the lamp exceeds the power of 400W, it is advisable to consider a distance photocell/luminous center of luminaire of approx. 15/20 m.

The minimum recommended length of the room is thus equal to 7.5 m (photocell – center of mirror) + 3 m (center of mirror – end wall) = 10.5 m:

- ▶ length > 7 m
- ▶ width 6.5 m
- ▶ height 7.2 m

The dimensions are smaller for machines with 1 m or 1.6 m mirrors.

Characteristics

Wall Colour - The laboratory walls should be painted in matt black and it's suggestable to cover the laboratory wall, ceiling and floor surfaces with black velvet type DC-Fix

Air conditioning system - The room must be equipped with an air conditioning system capable of maintaining the temperature of the area around to the appliance to be measured to the value of 25 °C +/- 1 °C

Further details may be provided in case of acquisition of the machine

N. B.

- ▶ Machine installation is carried out by OxyTech technicians.
- ▶ OxyTech reserves the right to make improvements to the machine at any time without obligation to inform.

T5+