VISO SYSTEMS

Guidelines

Practical measurement setup

Revision: December 2024

Congratulations on purchasing your new Viso Systems product. Before using this product, please read the Safety Information.

This manual contains descriptions and troubleshooting necessary to install and operate your new Viso Systems product. Please review this manual thoroughly to ensure proper installation and operation.

For news, Q&A and support at Viso Systems, visit our website at www.visosystems.com

Other manuals in this series (the latest version can be downloaded from www.visosystem.com).

Contents

1. Introduction

These guidelines describe the practical laboratory procedures that need to be in place before a measurement can be started on a Viso light measurement system.

Overall, the term DUT ("Device Under Test) is used to indicate the test luminaires (and if there is no luminaire, the light source itself).

The procedures include:

- Finding the photometric center of the DUT
- Placing the DUT correctly on the goniometer
- Finding the maximum dimension of the luminous surface
- Finding the best measurement distance
- Choosing an optimal measurement resolution

1.1. The operator's responsibilities

It is the system operator that is responsible for the procedures above. Following the procedures are essential for a correct result. The software has automatic features to help to the greatest possible extent, but still operators need to be competent in using the practical procedures of this manual.

- For issues related to electrical connections and cabling, please refer to the relevant user manual.
- For issues related to software and controls, please refer to the Light Inspector user manual.

2. Finding the photometric center of the DUT

The photometric center of the DUT is the point related to (usually within) the DUT (= DUT = Device Under Test) to be placed at the goniometer reference point. The exact photometric center can be unknown, can require extensive measurements to determine, and can vary with wavelength or angle.

A practical DUT center (based on the device geometry and the size, shape and position of the DUT within the DUT) can be used. The photometric center the DUT is usually based on the "center of gravity" of the area/volume that emits light, i.e., the centroid of the geometric shape of the luminous area.

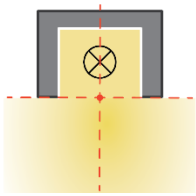
The reference center of the DUT itself is then determined taking the following into consideration:

Some practical advice

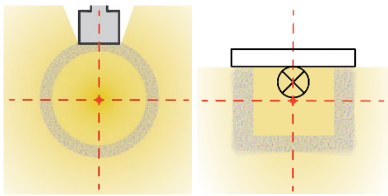
Ask yourself: Which parts of this DUT actually emit light? The light source/LED, obviously – but also reflective surfaces, lenses, refractors, diffusing materials and (semi-)transparent surfaces count.

Then ask yourself: If all of this light was emitted from a single point, where would that point be?
It helps to think about this like the "center-of-mass" for the light emission.

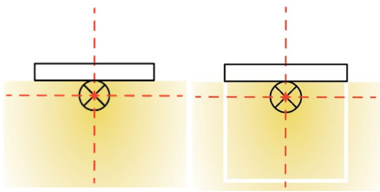
If the light source is surrounded by an opaque outer shell, then the photometric center is the intersection point with the axis passing through the geometric center of the light source and the plane of the border between the outer shell and the light emitting surface.
Typical products: Downlights, office lighting, projectors, and pendants.



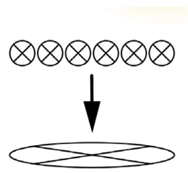
If the light source is surrounded by an outer shell that diffuses and transmits the light source, then the photometric center is the geometric center of the light emitting surface (including the diffusing and transmitting outer shell).
Typical products: Streetlights and pendants.



If the light source is surrounded by a transparent outer shell or the light source is exposed, then the DUT reference center is the geometric center of the light source.
Typical products: LEDs sources, work lights and streetlamps.



The DUT reference center of a luminaire in which multiple light sources emit light within the same light emitting plane is one of the above methods in which the multiple light sources as a whole are used as a single light source.
Typical products: LEDs sources, work lights and streetlamps.

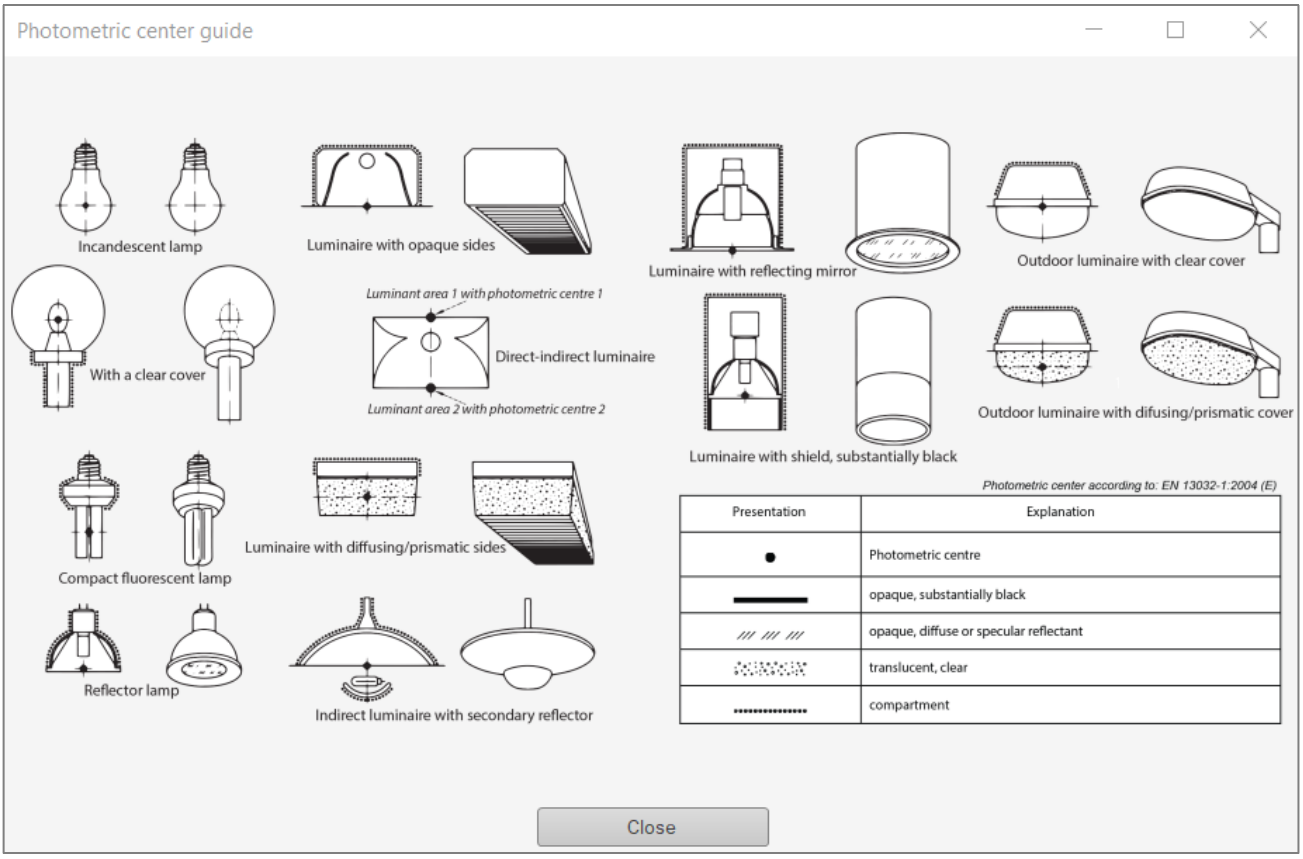


In the case where multiple light sources are separated in the DUT and the inverse square law of distance cannot be applied as one light source, the reference center is determined for each light emitting area and each light emitting area should be measured separately while being placed in the goniometer reference point.

For single LEDs or planar arrangements of LEDs the DUT reference center corresponds to the tip of the lens or top of the emitting surface. This is chosen for ease of implementation and conformity to CIE 127:2007 (CIE, 2007).

The following illustration is taken from the Light and lighting – measurement and presentation of photometric data of lamps and luminaires – Part 1. Measurement and file format. Standard EN13032-1_2004.

This menu point opens a guide to working with photometric centers. Read more in page **Error! Bookmark not defined.**, Internal Photometric Centers.



In the illustration below you will find some practical examples:

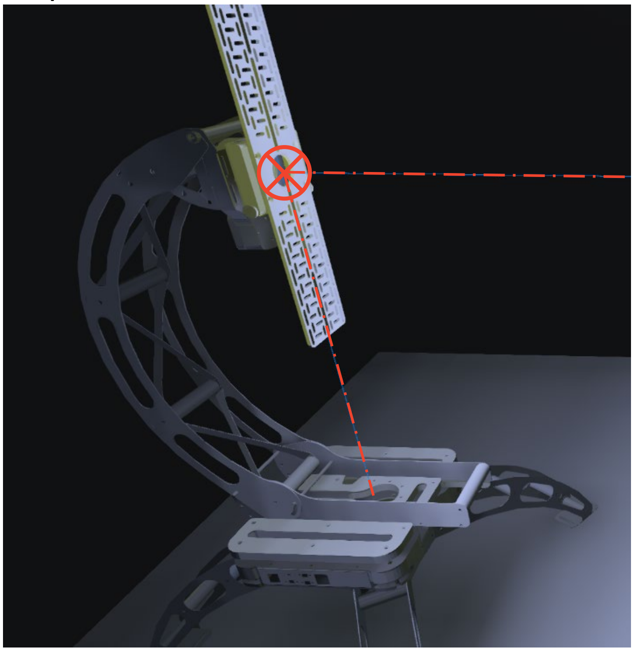
3. Placing the DUT correctly on the goniometer

When you have determined the photometric center of the DUT, you are ready to place the DUT on the goniometer.

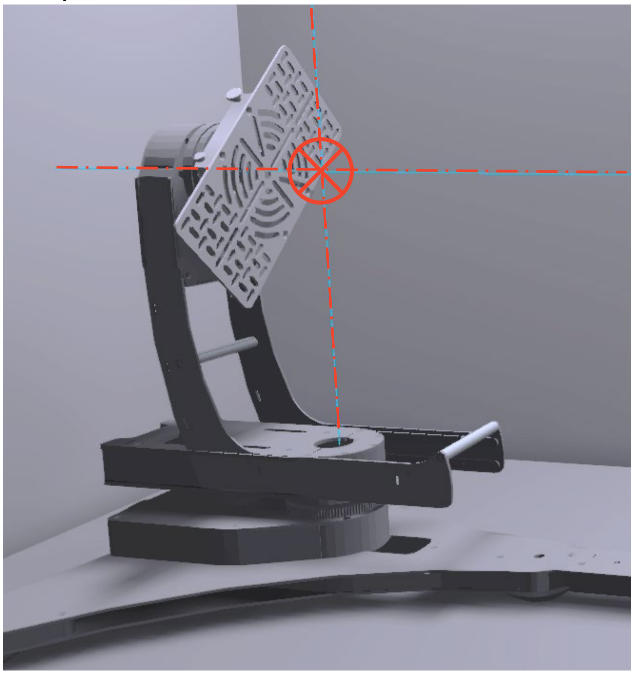
3.1. Placing the DUT in the center

The DUT photometric center must be placed where the two rotation axes of the goniometer intersect (on LightSpion where the vertical rotation axis and the sensor axis intersect).

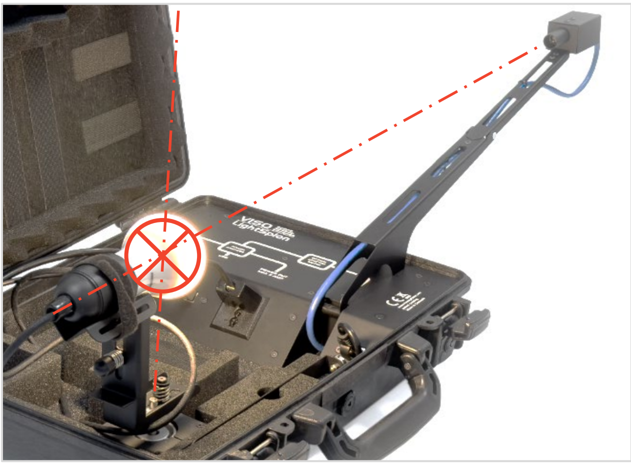
LabSpion:



BaseSpion:

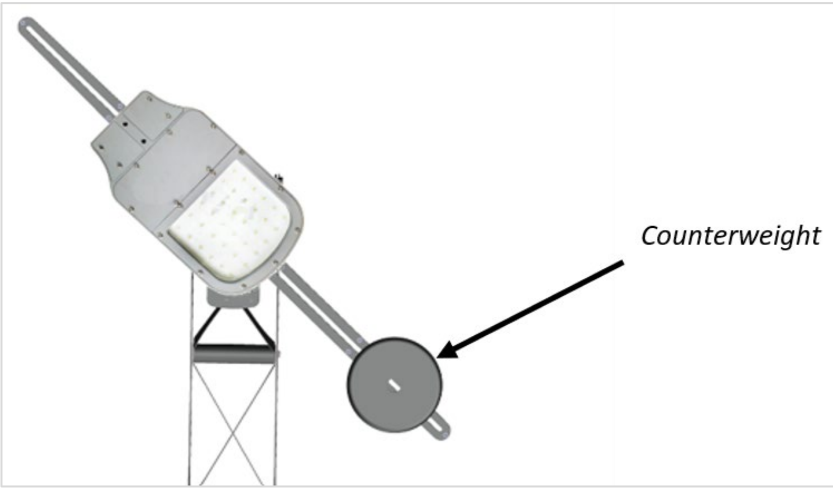


LightSpion:



3.2. Balancing the weight on the gonio lamp bracket.

Sometimes, placing the photometric center of the DUT correctly will cause the gonio arm to be unbalanced so that the arm cannot turn correctly. In that case, make sure to put on more weight in the opposite end: A counterweight.



When the arm is balanced correctly, you should be able to turn the arm manually an leave it permanently in any position).

3.3. Aligning the light source

The goniometer does not "know" how it is rotated/oriented, so the direction that you turn the lamp bracket and the base manually will be the start position. Every automatic measurement starts with the lamp being turned 90 degrees just to make it possible to detect any mechanical fixation problem before the measurement actually starts (except LightSpion).

! **It is recommended to lock the base (LabSpion/BaseSpion) while aligning the sensor and fixing the lamp, and if necessary to keep a level nearby to align the lamp vertically on the lamp bracket. Then unlock the base before starting the measurement.**

As the software does not "know" how the lighting fixture is actually positioned on the goniometer, it is very important that the fixture is aligned in a way that the "length" will actually be interpreted as "length" in posterior outputs.

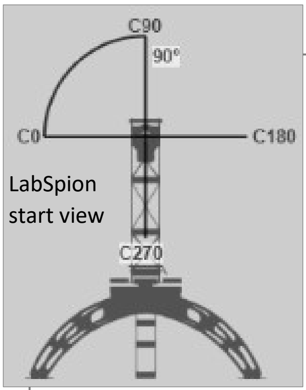
Orientation during measurement

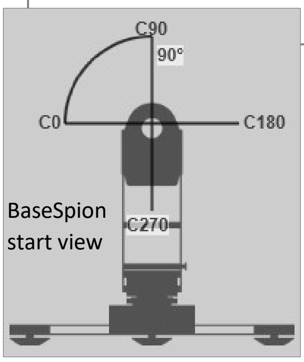
As there are two prevailing standards that work with different orientations there is you need to decide whether you want to work **"European style"** or "**US Style"**:

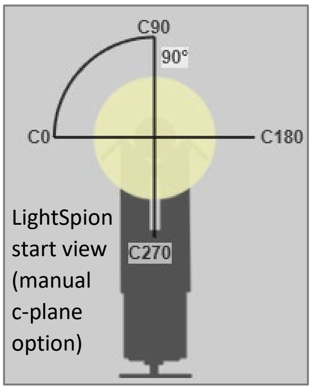
European style (CIE 121)

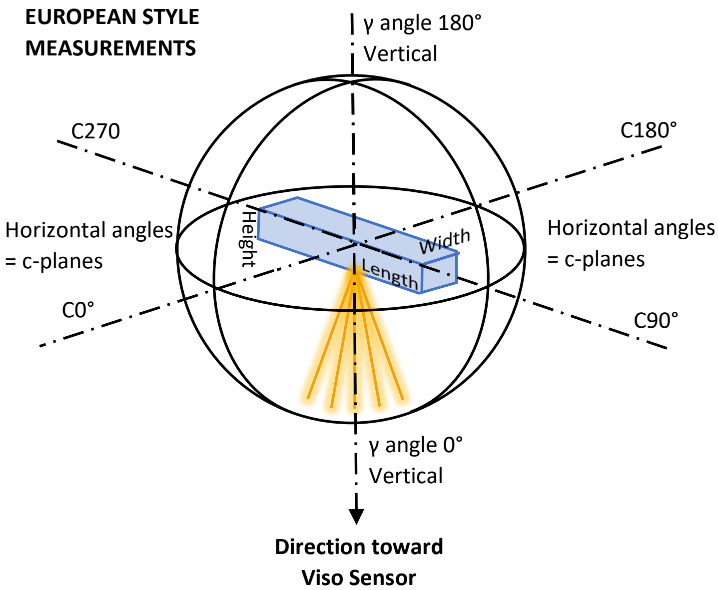
Choose European Style if your primary output is LDT files. Make sure that the measurement starts with the fixture having the *length being parallel to c9-c270* on the goniometer[1].

The image to the left shows the C-plane orientations of the LabSpion. BaseSpion and LightSpion work the same way).









Road lighting: Turn "street side" toward c0 and "house side" toward c180.

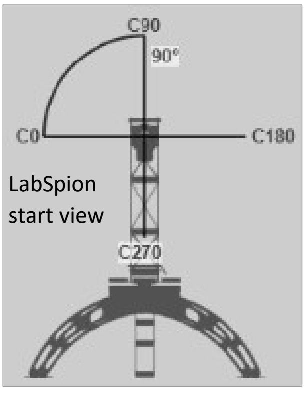
Please note that in advance of exporting European style measurements to IES the light distribution must be rotated 90 degrees.

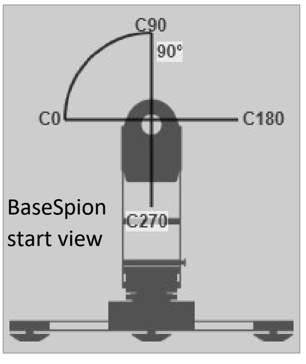
Alternative: Make a custom IES file format that swaps {LENGTH_M} and {WIDTH_M}, see page **Error! Bookmark not defined.**, Tab: Export.

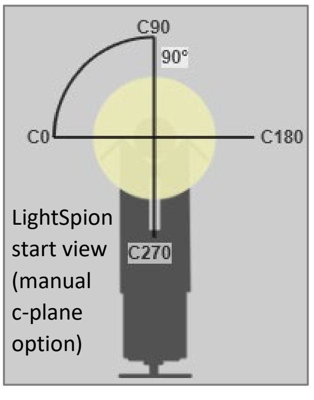
[1] Standardized in CIE 121-1996, section 2.8.

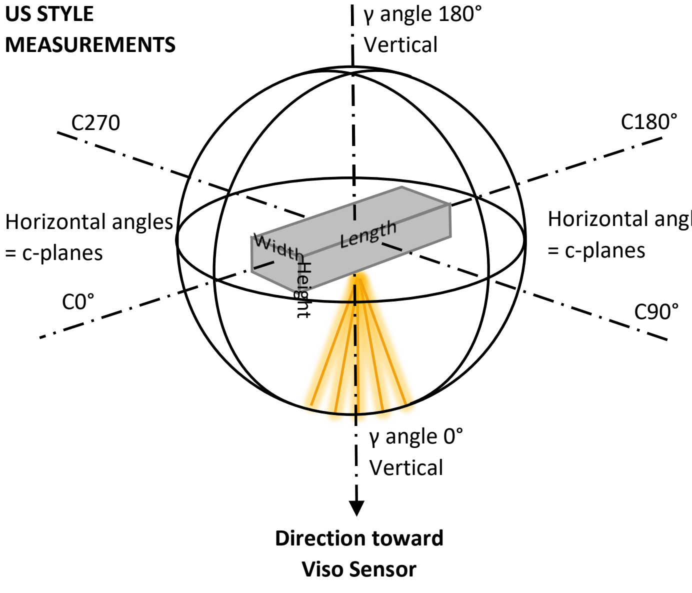
US style (LM63-02)

Choose US Style if your primary output is IES files. Make sure that the measurement starts with the fixture having the ***length being parallel to c0-c180*** on the goniometer[2].









<u>Road lighting:</u> Turn "street side" toward c0 and "house side" toward c180.

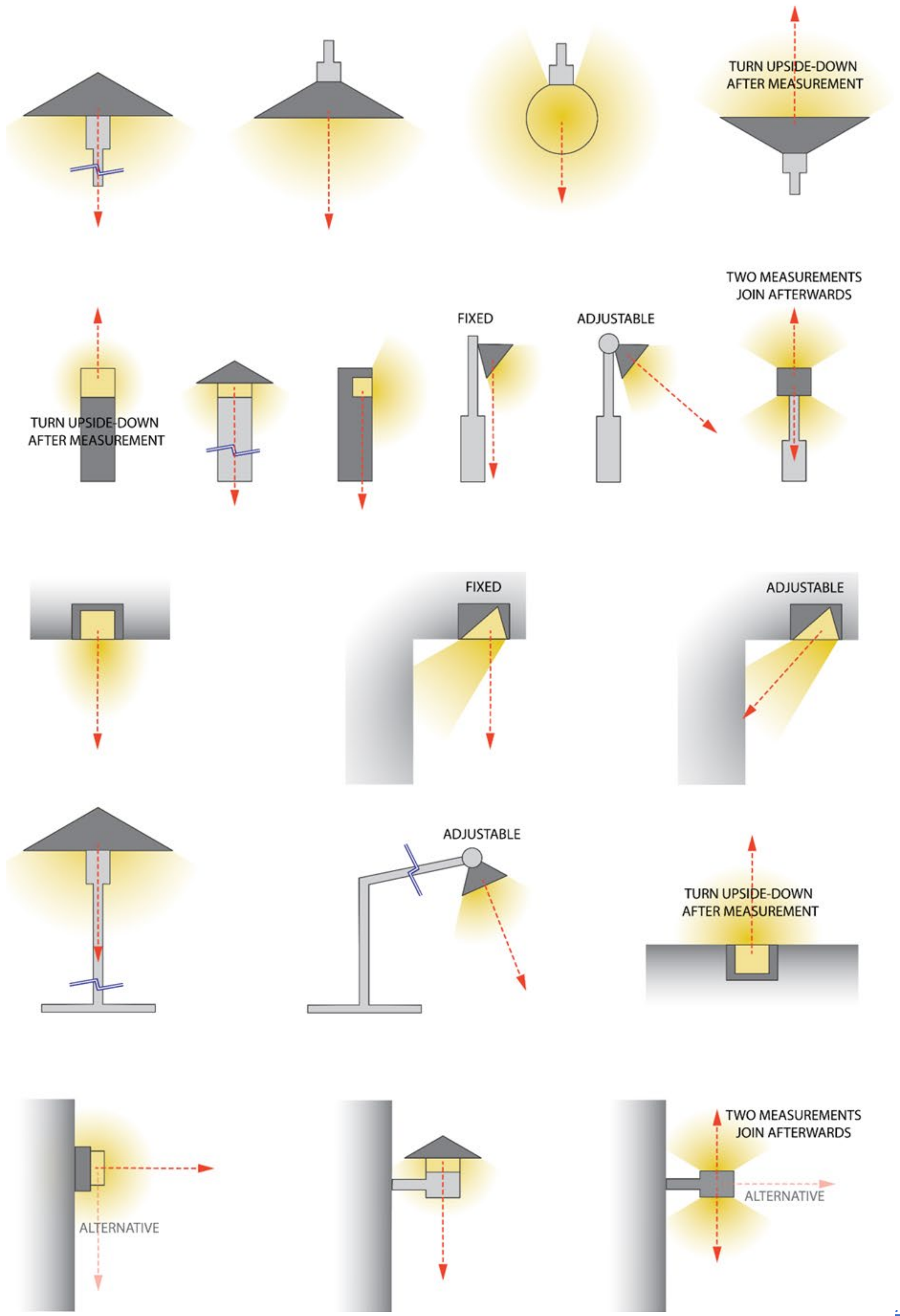
Please note that in advance of exporting US style measurements to LDT the light distribution must be rotated 90 degrees. Also please note that software UGR calculation assumes European style orientation.

Alternative: Make a custom LDT file format that swaps {LENGTH_LMP_MM} with {WIDTH_LMP_MM} and {LENGTH_MM} with {WIDTH_MM}.

[2] Standardized in LM63-02

Orientation during measurements

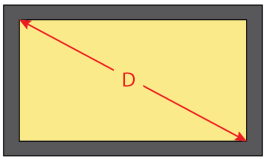
Direction toward Viso Sensor



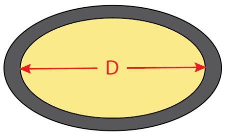
4. Finding the maximum dimension of the luminous area

For calculation of the necessary measurement distance, only the luminous area counts.

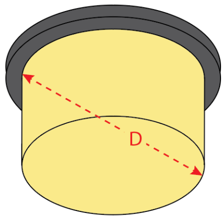
A rectangular or square panel: The maximum dimension of the luminous surface is the diagonal



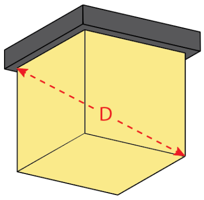
An elliptical or a circular panel: The maximum dimension of the luminous surface is the major axis or the diameter.



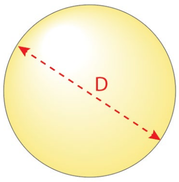
For a cylindrical luminous area: The maximum dimension of the luminous surface is the diagonal from the side on one end to the opposite side on the other end.



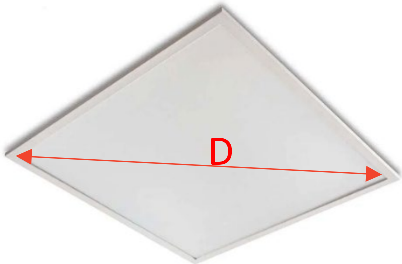
For a cubic luminous area: The maximum dimension of the luminous surface is the diagonal from the corner to the opposite corner.



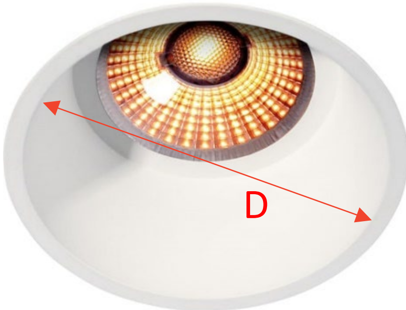
For a spherical or ellipsoid area: The maximum dimension is the diameter or the major axis.

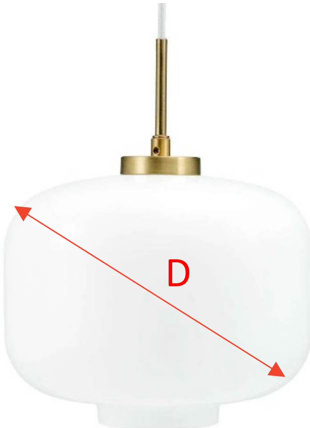


The luminous surface should be interpreted as **all surfaces that emit light** <u>including reflected light (reflectors regardless of color) or transmitted light (diffusers etc.).</u> The biggest dimension of the luminous surface could be a diagonal or a diameter:


D


D


D


D

5. Finding the best measurement distance

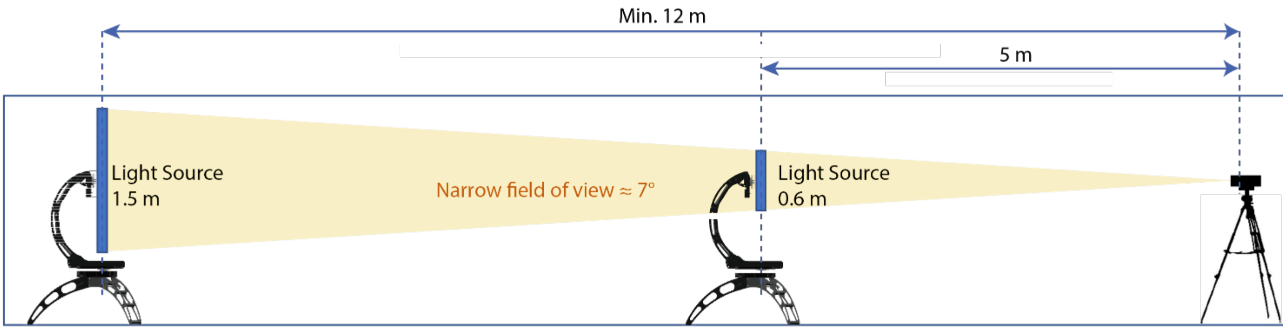
All Viso systems are so-called far-field systems, which means that the distance from the DUT (the photometrical center of the DUT placed in the photometrical center of the goniometer) to the sensor should be long enough to ensure that the DUT can (approximately) be assumed to be point-shaped (having no physical dimensions). For practical reasons, standards require a minimum distance of 5-15 times the biggest dimension of the luminous surface.

Viso measurement systems need a minimum of 8 times the maximum dimension of the DUT luminous surface – e.g., the diagonal. This is because Viso sensors include narrow field-of-view optics to increase the sensitivity and limit the influence of straylight from laboratory surroundings.

Consequently, you need to adjust sensor distance to adapt to the size of the DUT.

For LightSpion, the sensor distance is given (66 cm, or with extender 114/181 cm), and so the DUT max. dimension is restricted to 8 cm – and with extender to 14/22 cm.

On BaseSpion and LabSpion, the distance can be changed – and can both be too long and too short.



You do not necessarily need to move your sensor every time a new DUT is measured: If the measurement distance is over the required minimum and not too long (see below), then there is no need to move the sensor (and realign on LabSpion).

5.1. Consequences of choosing a sensor distance that is too short

If the sensor is placed too close to the DUT, the sensor will not be able to “see” the whole DUT, and the lumen output will be less than expected.

This is also the result if the luminous surface is not mounted symmetrically on the lamp bracket. In this case, one end will not be “seen” by the sensor.

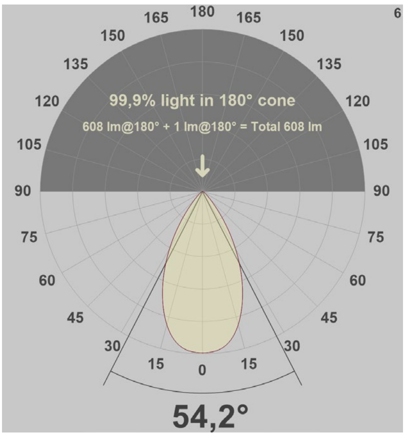
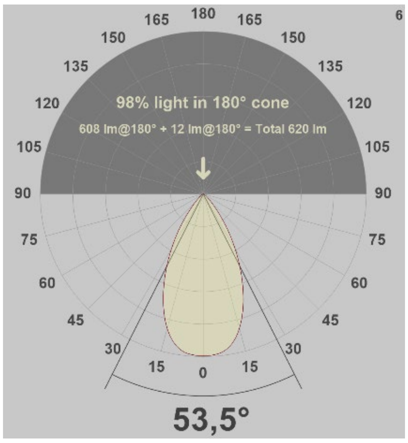
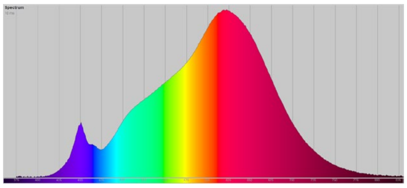
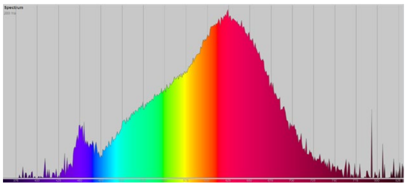
5.2. Consequences of choosing a sensor distance that is too long

If your sensor is too long, your signal-to-noise ratio will be decreased, and you may get a very noisy result.

The inverse square law applies to the signal: The signal drops with the distance squared.

To compensate for an inferior signal, the Viso system will increase the measurement time in each measurement point, the so-called integration time. Having a long integration time increases the influence of signal noise. But having a very long integration time may also cause the goniometer to move slowly. You will see the process slowing down if your integration time increases to more than 0,3-0,4 seconds.

Example – the same DUT (Ø 10 cm), measured in two different setups:

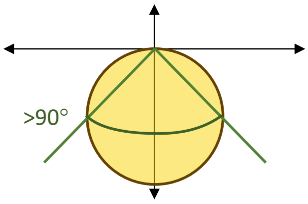
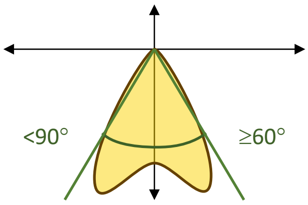
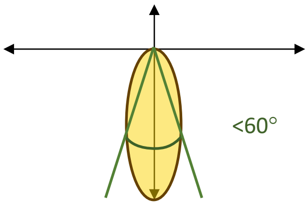
Correct distance	Distance too long
Test distance 91 cm (608 lm) Integration time = 10 ms	Test distance 327 cm (608 lm) Integration time = 200 ms
	 The extra 11-12 lumen in the upper hemisphere are noise. Also, the beam angle is slightly off.
	
This spectrum is nice and smooth.	The spiky spectrum indicates that there is a lot of noise in the measurement.
Signal OK	Signal is (91*91)/(327*327) = 7,7% of the signal at the minimum distance.

5.3. What do standards say about sensor distance?

Viso systems all work with "far-field" measurements.

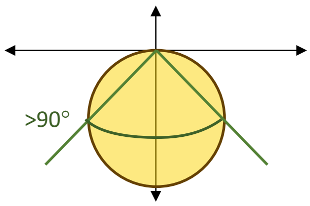
World standard CIE S 025/E:2015 and European standard EN13032

According to CIE S 025/E:2015, minimum measuring distances should be (D is the largest dimension of the luminous area):

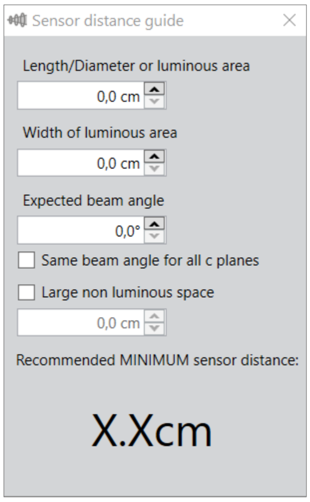
	For DUTs having near-cosine (Lambertian) distribution, beam angle ≥90°:	Sensor distance ≥5xD **(in Viso systems: ≥8xD)**
	90° > Beam angle ≥60	Sensor distance ≥10xD
	Beam angle <60° Narrow angular distribution / steep gradients	Sensor distance ≥15xD
	Large non-luminous areas with maximum distance S	Sensor distance ≥15x(D+S)

American standard LM79-18

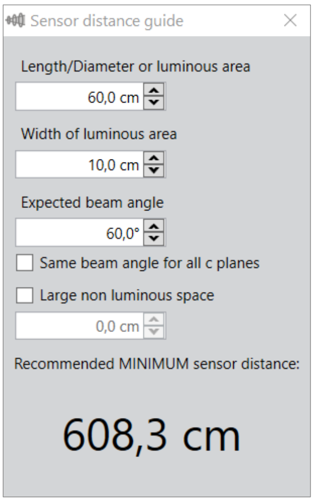
According to LM79, minimum measuring distances should be (D is the largest dimension of the luminous area):

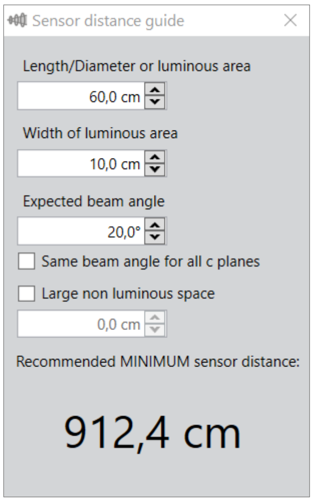
	For DUTs having near-cosine (Lambertian) distribution, beam angle ≥90°:	Sensor distance ≥5xD **(in Viso systems: ≥8xD)**
Beam-forming DUTs	Beam angle < 120°	Sensor distance most be longer than ≥5xD – how long must be determined by experimentation

There is a software tool that effectively helps you to calculate the correct minimum sensor distance according to CIE S025 (since LM79 is unclear concerning beam-forming DUTs): Go to Help → Sensor Distance Guide. Just type your dimension details into the calculator (in centimeters).



Examples:





5.4. Recommendations

Always use the Sensor Distance Guide to calculate your minimum distance and set your sensor distance slightly above this minimum.

For extremely powerful narrow beam DUTs, the sensor may oversaturate. Often this can also be overcome by moving the sensor further way. Doubling the distance will reduce the sensor irradiance to 25%.

LabSpion: Measuring the distance to a "hidden" photometric center.

On LabSpion: Whenever moving the sensor, remember to actively measure the distance laser from the sensor to the light source.

If the DUT photometric center is not on the front of the luminaire, you may

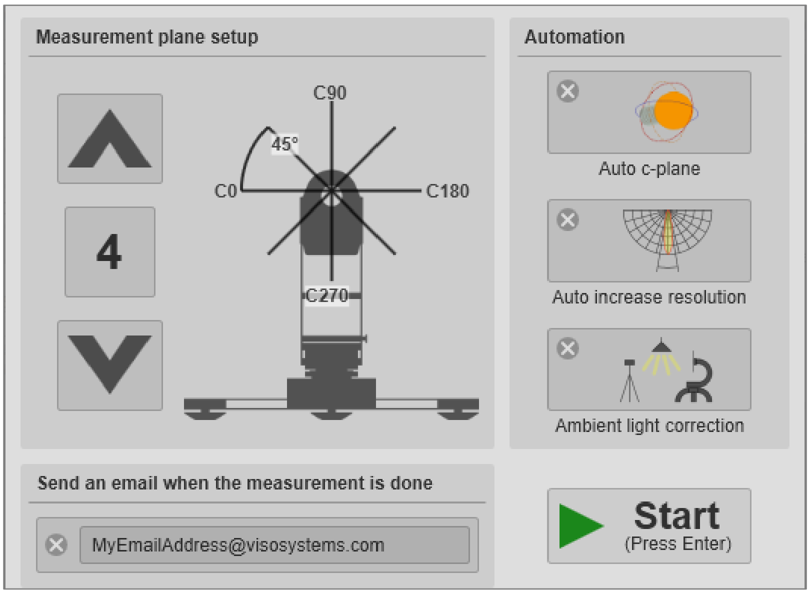
- move the tower backward, until in front is aligned with the gonio vertical rotation axis
- measure the distance with the laser
- Move the tower forward again to align you DUT photometric centre with the gonio vertical rotation axis

The actual distance measurement can be checked by measuring (e.g., with a ruler) from the gonio center axis to the front of the sensor housing, and adding:

- +5,9 cm for LabSpion Sensor model I
- +11,5 cm for Labspion UV-VIS/UV-VIS-NIR/VIS-NIR Sensor II
- +12,1 cm for Labspion VIS Sensor II.

6. Choosing the right measurement resolution

6.1. Choice of C-plane Quantity



The LabSpion and BaseSpion both have the option of measuring multiple C-Planes automatically, so pressing the “play” button to start a measurement, a window will appear where the number of planes for this measurement can be set. Default is a full sweep in a single plane (equals two opposite C-planes). Up to 36 full planes (equaling 72 C-planes, and a 5° resolution) are possible.

LightSpion measures a single plane (=2 c-planes). More planes are possible with manual C-Plane rotation is possible, see the LightSpion manual.

Read more about 3D measurement resolution (C-planes and γ-steps) in https://data.visosystems.com/content/manuals/light_inspector_user_manual.pdf section 3.1, Measurement Fundamentals.

Pressing and holding the arrow buttons allows you to scroll quickly through the number of planes. Typing the desired number is also possible in the field below.

6.2. Correct no. of measurement planes

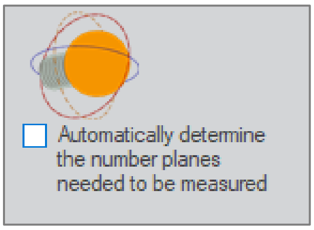
There is no standard that specifies the correct number of c-planes, but general advice can be given:

- Accurate alignment is essential – for symmetrical light sources, the more accurate, the less planes are needed.

- Diffuse light sources with wide beam angles do need many measuring planes. If aligned very accurately then 1 plane (= 2 planes) is in principle enough (as on LightSpion). Viso recommends using minimum 2-4 measuring planes to make sure any misalignment can be detected.
- For asymmetrical light sources, more measuring planes are needed. Viso recommends using 12-36 planes.
- For narrow beam (less 15-20° beam angles) Viso recommends minimum 12 planes. This is because narrow beam light sources are harder to align, so chances are that the plane containing the peak intensity will be missed. Viso recommends using 12-36 planes.
- When in doubt, run the autodetection mode described below.

6.3. Autodetection Mode

Version 5.87 or later will allow you select a feature that detects a recommended number of measuring planes. When ticking this box, the measurement will start with a pre-measurement that detects light distribution asymmetry/spikiness and bases the recommended number of planes on this analysis.



As off version 7.14:

6.4. Auto-Increase Gamma Resolution Mode

Beside the number of C-planes ("horizontal resolution") the system also needs an adequate vertical resolution, γ (Greek letter *gamma*). Per default, the system is set up to run with a basic 5° γ-resolution. It is also set up to detect during measurement whether this needs to be increased. When the system finds that increasing the resolution should be considered, a dialog box will open. If you want the system to increase measurement γ-resolution automatically without asking you should tick off the box "Do not ask...etc."

As off version 7.14:

! **It is recommended to leave the gamma (vertical) resolution in the basic 5-degree setting and tick the box in the start window that allows the system to pick the optimal resolution automatically. This is the best way to ascertain a good characterization while also keeping the total measurement time down.**

At Viso Systems we design, develop and manufacture OEM- and customer-specific goniophotometer solutions. Our mission is to support customers with powerful and yet easy to use control measurements solutions. Products are developed and manufactured in Copenhagen, Denmark.

Light measurement made easy