

We bring quality to light.



## ISP Series Integrating Spheres

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# The Integrating Sphere

## The working principle

Using integrating spheres to determine the radiant power or luminous flux from light sources is one of the most important procedures in light measurement. The interior surface of the hollow sphere is coated with a diffuse reflecting material, e.g. barium sulfate ( $\text{BaSO}_4$ ), and the integrating sphere therefore guarantees complete mixing of the radiation. Multiple reflections ensure that the light is distributed uniformly throughout the sphere, independently of the original spatial radiation pattern of the light source. A detector measures the so-called induced irradiance  $E_{\text{ind}}$  on the inside sphere wall which provides a direct measurement for the total luminous flux  $\Phi$  of the test specimen. Where  $\rho$  is the reflectance of the sphere coating and  $R$  is the radius of the sphere, the following relationship applies for an ideal integrating sphere derived using the principle of multiple reflections:

$$E_{\text{ind}} = \frac{\Phi}{4\pi R^2} \cdot \frac{\rho}{1-\rho} = \frac{\Phi}{4\pi R^2} M(\rho)$$

$E_{\text{ind}}$ : induced irradiance,  $\Phi$ : total luminous flux,  $\rho$ : reflectance of coating,  $R$ : sphere radius,  $M(\rho)$ : sphere factor

The sphere factor  $M(\rho)$  specifies how much the throughput of the integrating sphere varies as a function of the reflectance. The formula clearly shows that the measured luminous flux does not depend on the position or angle of the detector but only on the size of the sphere and the properties of the coating.

The reflectance of an integrating sphere is a decisive factor for the attainable measuring accuracy. A maximally high reflectance close to 100 % is desirable in order to achieve optimum mixing of the light. However, the sensitivity to dirt and ageing of the coating goes up as the reflectance increases. The variations in the spectral throughput of the sphere also increase as a result. By contrast, a low reflectance produces greater dependence on the spatial light distribution alongside lower throughput.

## Aspects of measurement reality

Many details have to be taken into account for realization of the integrating sphere in order to guarantee the most precise measurement. Potential sources of measurement error resulting from the sample table, baffles, cables and even the test specimen itself need to be kept as low as possible.

The detector is positioned at a small port in the wall of the sphere and has to be protected against direct irradiation by a baffle in order to comply with the measuring principle of multiple reflections. The detector also needs to have good cosine correction, i.e. the signal sensitivity must change with the cosine of the angle of incidence, in order to obtain an accurate measurement for  $E_{\text{ind}}$  and hence  $\Phi$ . The installed baffles must be designed as small as possible and should be located halfway or a third of the distance between the source and the detector as recommended in the guideline IES LM-79.

The test specimen should always be significantly smaller than the internal diameter of the sphere, in order to keep the interference factor caused by the sample itself as low as possible. However, the incident light intensity on the detector decreases as the sphere gets bigger. As a rule of thumb, the light throughput of an integrating sphere is a function of the inverse square of the sphere's radius. Selecting the correct relationship between the size of the test object and the size of the sphere is therefore crucial for an effective balance between high measuring quality and good throughput.

#### Guidelines for selecting the correct size

##### ➤ 4 $\pi$ geometry

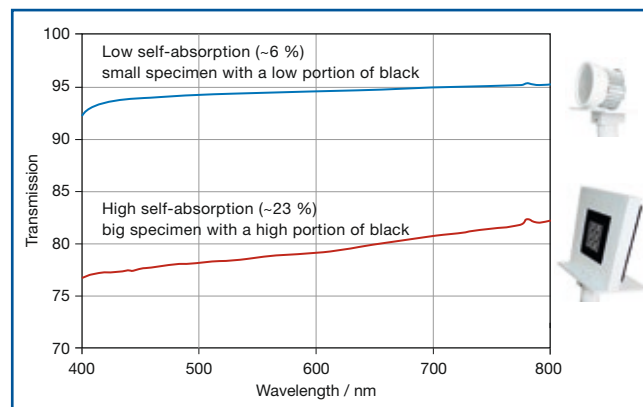
The total surface of the test sample should be smaller than 2 % of the surface of the sphere. The length of a linear lamp should be less than 2/3 of the diameter of the sphere.

##### ➤ 2 $\pi$ geometry

The diameter of the measuring port and hence the maximum extension of the test specimen should not exceed 1/3 of the sphere diameter.

### Self-absorption correction

The test object itself contributes to the absorption of light radiation in the integrating sphere. This form of interference known as self-absorption can result in a significant attenuation of light radiation and leads to deviations in measurement. This attenuation becomes more pronounced as the test specimen becomes bigger and



Various self-absorption spectra

darker. A self-absorption correction with the assistance of a suitable auxiliary light source is therefore essential for precise measurements. A halogen lamp covering a wide spectral range is typically used for this purpose. The auxiliary light source must be positioned behind a baffle in order to avoid illuminating the sample directly and it should be operated by a stable power supply. This light source is used to determine the spectral absorption behavior of the device under test, the sample holder and the connecting cables, and then offset with the actual

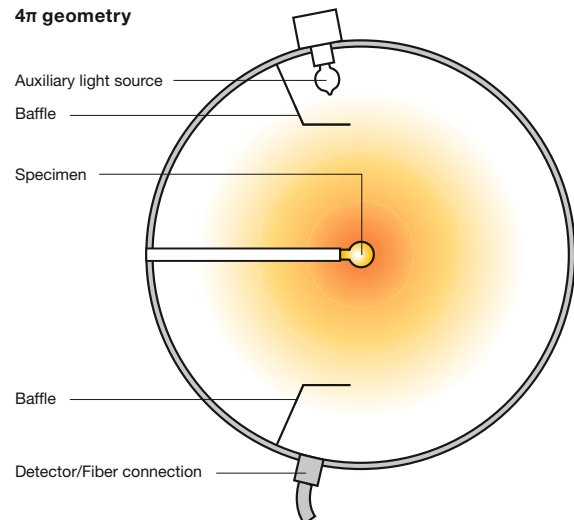
measurement. The effect of self-absorption increases as the reflectance of the coating rises and the ratio of the area of the sphere to the test specimen decreases.

### Measuring geometries

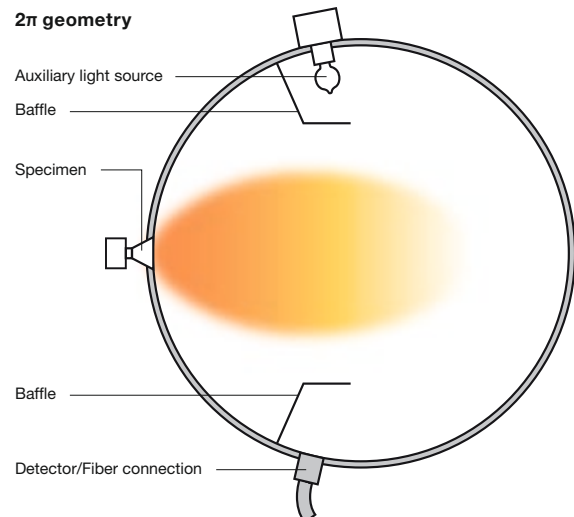
4 $\pi$  geometry is the conventional configuration for measuring luminous flux. This involves the light source being positioned at the center of the sphere. The radiation emitted in all directions is captured and the total luminous flux is measured.

A measurement configuration has been established in 2 $\pi$  geometry for light sources which have negligible or no radiation directed backwards. Here, the light source is located at a port in the wall of the sphere. Only the light radiation emitted in the front hemisphere is recorded for the measurement. This forward radiation is typical for most LED products. The integrating sphere must be calibrated absolutely based on the measuring geometry in conformity with the substitution principle.

#### 4 $\pi$ geometry



#### 2 $\pi$ geometry



4 $\pi$ - and 2 $\pi$ -measuring geometry



## Integrating spheres for all applications

Instrument Systems developed a complete family of integrating spheres in the ISP Series with the objective of marketing a broad spectrum of sizes and functionalities. Integrating spheres with diameters from 75 mm to 2 m therefore allow the characterization of a wide range of different light sources with a very high level of precision.

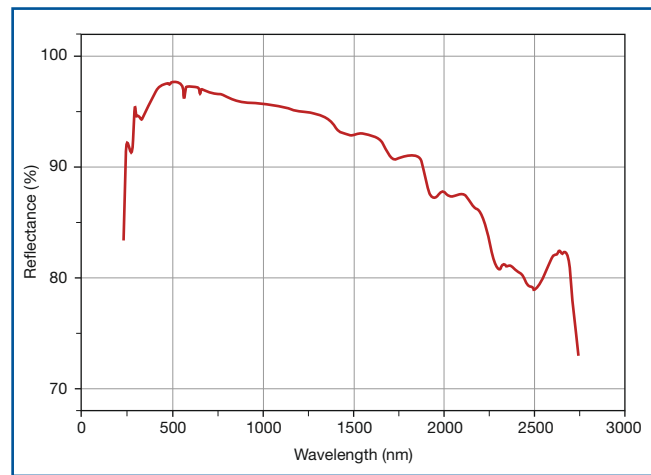
A key issue in selecting a suitable sphere for the designated application is the maximum size of the sample to be measured. The size of the integrating sphere should increase with the size of the light source in order to keep measurement errors to a minimum.

### Conformity and measuring geometries

All integrating spheres from Instrument Systems are in conformity with the guidelines CIE 127:2007 and IES LM-79-08 in respect of concept, construction and functionality. The complete ISP Series has a measuring port at the side to determine luminous flux in  $2\pi$  configuration. In accordance with the recommendations referred to, this measuring port is always less than  $1/3$  of the diameter of the sphere limiting the maximum dimension of the luminaire being measured to an optimal amount.

Integrating spheres with an internal diameter greater than 500 mm can be conveniently opened using a swivel or slide mechanism. The test specimen can be positioned in

the center of the sphere using sample tables or lamp posts in order to measure the luminous flux in the  $4\pi$  configuration.



Reflectance of the BaSO<sub>4</sub> coating

### Coating and spectral range

All integrating spheres have a barium sulfate (BaSO<sub>4</sub>) coating with a reflectance of approximately 97 % in the photometric spectral range. The coating exhibits minimal ageing effects and has a particularly low fluorescence level. It covers a wide spectral range from 240 to 2600 nm.



The complete model range can be used with all spectroradiometers from Instrument Systems. A fiber bundle is generally used to connect the sphere to a spectroradiometer which is optimized for the relevant spectral range.

### Choosing the right sphere








The right choice of sphere depends on the size of the light source under investigation and the measuring task. Potential measuring errors are minimized with all models in the ISP Series through the optimized ratio between sphere surface and area of the measuring port to yield a high level of measuring accuracy.

The small sphere models from Instrument Systems with diameters of 75 mm, 100 mm and 150 mm were specially developed for measuring single LEDs in production and

laboratory. The mid-range sizes of 250 mm and 500 mm are ideal for LED modules or small lamps with a relatively low output.

The ISP 1000 has a diameter of 1 m and is ideally suited to a wide range of applications. The characteristics of high-power LEDs, large LED modules and lamps can be determined in both measuring geometries. The ISP 2000 is the biggest model in the family and this is the integrating sphere of choice for large luminaires and SSL (Solid State Lighting) products.

### Overview of the integrating spheres in the ISP Series

Model	ISP 75	ISP 100	ISP 150L	ISP 250	ISP 500	ISP 1000	ISP 2000
							
Inside diameter	75 mm	100 mm	150 mm	250 mm	500 mm	1000 mm	1900 mm
Diameter of the measuring port	15 mm	33 mm	50 mm	75 mm	150 mm	300 mm	600 mm
4 $\pi$ measurement	No	No	No	No	Optional	Yes	Yes
Auxiliary light source	No	No	Optional	Yes	Yes	Yes	Yes
Temperature sensor	No	No	No	No	No	Yes	Yes
Application	Single LEDs and LED chips	Single LEDs and LED chips	Standard und High-power LEDs	Single LEDs, small LED modules and SSL products	Mid-sized LED modules and standard lamps	Large LED modules, standard lamps and small (SSL) lamps	All types of lamp, luminaires and SSL products
Versions	- Production environment - Laboratory applications	- Production environment	- Production environment - Laboratory applications	-/-	- Closed version - Opening version	- Fixed version - Rotatable version	-/-
Accessories	- Mount for LED test sockets - Protective window	- Protective window	- Protective window or protective dome - Mount for LED test sockets	- Reduction of the measuring port to 50 mm with protective glass - Mount for LED test sockets - Mount for TEC test adapters	- Mount for LED test sockets - Mount for TEC test adapters - Lamp post (vertical and suspended) - Sample platform	- Mount for LED test sockets - Mount for TEC test adapters - Lamp post (vertical and suspended) - Sample platform	- Lamp post (vertical and suspended) - Sample platform - Sample holder for fluorescent tubes
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#### Key features at a glance

##### ISP 75

- For standard single LEDs and LED chips
- 75 mm inside diameter, 15 mm measuring port
- Mount at the measuring port for LED test sockets
- Version for assembly at LED handler or wafer prober

##### ISP 100

- Optimum size for constricted space in the wafer prober
- 100 mm inside diameter, 33 mm measuring port
- Optional: protective silica glass window for the measuring port

## ISP 75 and ISP 100 – perfect for LED production

### ISP 75

The ISP 75 was specially developed for characterization of standardized single LEDs and LED chips in the production environment. The 15 mm measuring port makes the ISP 75 ideal for installation in production equipment. The measuring port can be adjusted for different LED types and sizes with the assistance of apertures. A silica glass window is provided as an option for protection against dirt and environmental influences.

### ISP 100

The dimensions of the ISP 100 were specially optimized for integration in the LED production environment. It provides maximum measuring accuracy with minimum size. The ISP 100 is ideal for applications with an LED handler or a wafer prober.

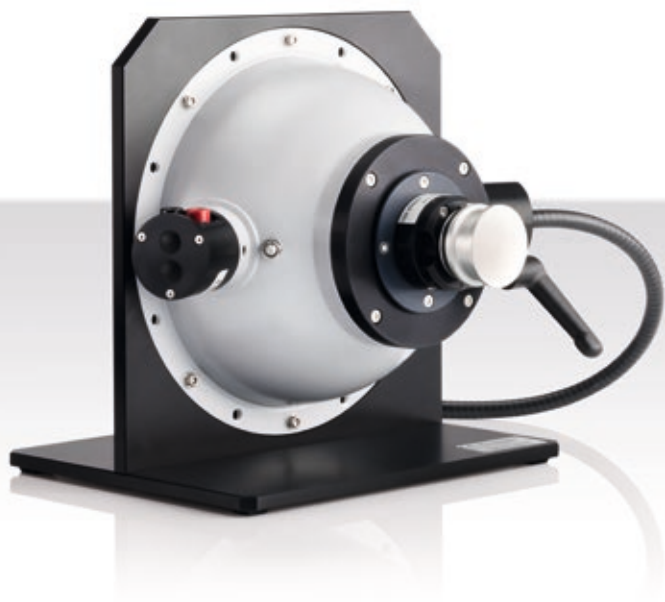
The test specimen in LED production is typically positioned at a distance to the measuring port of the integrating sphere when measurements are taken. This setup always relates to measurement of partial luminous flux. The ISP 100 has a comparatively large measuring port so that effectively the total luminous flux is measured.

### Technical specifications

Specification	ISP75-130	ISP100-130
Inside diameter	75 mm	100 mm
Diameter of the measuring port	15 mm	33 mm
Outside dimensions (D x H)	Ø 86 x 84 mm	Ø 119 x 110 mm
Weight	ca. 0.5 kg	ca. 0.8 kg

### Ordering information

Order no.	Description
<b>ISP 75 Integrating sphere</b>	
ISP75-130	Integrating sphere with 75 mm inside diameter; measuring port with 15 mm ø; version for assembly at the handler machine or prober
ISP75-250	Turnkey system for laboratory applications; spectral range 380 – 1600 nm; comprises ISP 75, stand and fiber bundle (OFG-414, PLG-410)
<b>Options</b>	
ISP75-140	Protective window made of silica glass for the measuring port of the ISP75-130
<b>ISP 100 integrating sphere</b>	
ISP100-130	Integrating sphere with 100 mm inside diameter; measuring port with 33 mm ø; version for assembly at the handler machine or prober
<b>Options</b>	
ISP100-140	Protective window made of silica glass for measuring port of the ISP100-130



#### Key features at a glance

- Turnkey system for applications in the laboratory or OEM version for production applications
- 150 mm inside diameter, 50 mm measuring port
- Optional: Protective window or dome made of silica glass for measuring port
- Optional: Auxiliary light source to compensate for self-absorption

## ISP 150L – for production and laboratory

The dimensions of the ISP 150L make it ideal for production applications where space is a priority. A stand-alone version is supplied for use in the laboratory. A window (35 mm diameter) or alternatively a dome (36 mm diameter) made of silica glass are supplied as an option for the measuring port and protect the sensitive BaSO<sub>4</sub> coating against contamination and environmental impacts.

### Technical specifications

Specification	ISP150L-130
Inside diameter	150 mm
Diameter of the measuring port	50 mm
Dimensions (D x H)	Ø 181 x 148 mm
Operating voltage / Power of the auxiliary light source	6 V / 10 W
Weight	approx. 0.6 kg

### Ordering information

Order no.	Description
<b>ISP 150L Integrating sphere</b>	
ISP150L-130	Integrating sphere with 150 mm inside diameter; measuring port with 50 mm Ø, angled connector for fiber bundle; version for assembly in the handler machine or prober
ISP150L-131	Integrating sphere ISP150L-130 with halogen auxiliary light source
ISP150L-250	Turnkey system for laboratory applications; spectral range 380 - 1600 nm; comprises ISP150L-131, ISP150L-211, stand and fiber bundle (OFG-414, PLG-410)
ISP150L-251	Turnkey system for laboratory applications; spectral range 240 - 1350 nm; comprises ISP150L-131, ISP150L-211, stand and fiber bundle (OFG-424, PLG-420)
<b>Options</b>	
ISP150L-140	Protective window made of silica glass for measuring port of the ISP 150L with 35 mm Ø
ISP150L-143	Protective dome made of silica glass for measuring port of the ISP 150L with 36 mm Ø
ISP150L-211	Adapter plate for LED test sockets with 25 mm Ø
ISP150L-215	Adapter plate for LED test sockets with 25 mm Ø; for version with protective dome ISP150L-143
PS-100	Stabilized power supply 0-16 V, 0-5 A for auxiliary light source



#### Key features at a glance

- Ideal for all single LEDs, high-power LEDs and small LED modules
- 250 mm inside diameter, 75 mm measuring port
- Holder for LED test sockets and TEC test adapters
- Integrated auxiliary light source to compensate for self-absorption

## ISP 250 – great for high-power LEDs, and small LED modules

The ISP 250 is ideal for characterization of single LEDs, high-power LEDs, small LED clusters and LED modules. The diameter of 250 mm means that it provides an ideal compromise between size and precision for these applications.



Auxiliary light source

The ISP 250 has a default integrated 10 W auxiliary halogen light source in order to determine and correct the self-absorption of the test sample.

#### LED test sockets and TEC test adapters

The basic unit of the ISP 250 has a universal measuring port with a diameter of 75 mm. Easily interchangeable adapter plates can be flange-mounted on the basic unit.

An adapter plate is supplied for LED test sockets from Instrument Systems with 25 mm diameter. A clamping ring at the plate helps to accommodate reproducibly all available test sockets. The measuring port of the adapter plate can be adjusted to suit the individual LED size with a set of apertures in the increments 7, 10, 15 and 20 mm.



Mount for LED test sockets



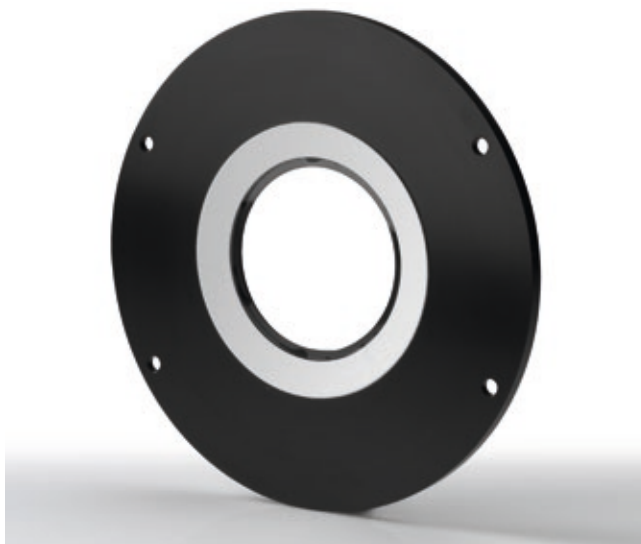
In addition, a special mount was developed for the TEC test adapter LED-850, and for the TEC test adapter LED-870. A robust base plate with clamping jaws provides easy and reliable positioning for the test adapters. High-power LEDs and small LED modules can be temperature controlled and characterized with this option.



Base plate with clamping jaws and TEC test adapter LED-870

### Reduction of measuring port

The measuring port of the ISP 250 can be reduced to 50 mm for applications in production. A special adapter plate is supplied with a protective disc made of silica glass which protects the BaSO<sub>4</sub> coating against dirt and damage.



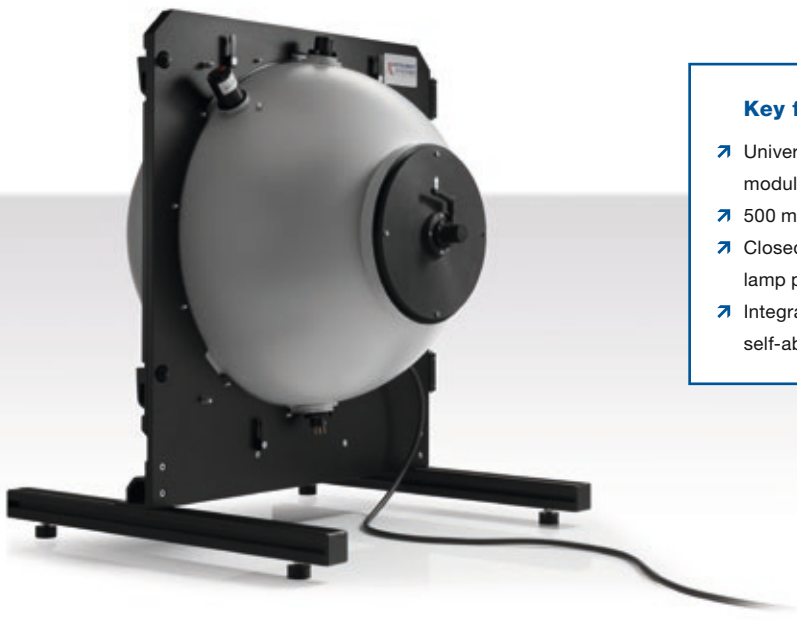
Adapter plate with 50 mm measuring port and protective window

### Technical specifications

Specification	ISP250-110
Inside diameter	250 mm
Diameter of the measuring port	75 mm
Outside dimensions (B, D, H)	360 x 324 x 362 mm
Operating voltage / Power of the auxiliary light source	6 V / 10 W
Weight	approx. 3.6 kg

### Ordering information

Order no.	Description
<b>ISP 250 Integrating sphere</b>	
ISP250-110	Integrating sphere with 250 mm inside diameter including halogen auxiliary light source; measuring port with 75 mm Ø
ISP250-250	Turnkey system for spectral range 380 - 1600 nm, comprising ISP250-110, ISP250-211 and fiber bundle (OFG-414, PLG-410)
ISP250-251	Turnkey system for spectral range 240 - 1350 nm, comprises ISP250-110, ISP250-211 and fiber bundle (OFG-424, PLG-420)
<b>Options</b>	
ISP250-143	Protective dome made of silica glass for the measuring port
ISP250-211	Adapter plate for LED test sockets with 25 mm Ø, incl. aperture set with 7, 10, 15 and 20 mm port
ISP250-215	Adapter plate for LED test sockets with 25 mm Ø, incl. aperture set with 7, 10, 15 and 20 mm port; for version with protective dome
ISP250-220	Adapter flange for TEC test adapter with 50 mm Ø, incl. aperture with 25 mm port
ISP250-225	Adapter flange for TEC test adapter LED-870
ISP250-260	Adapter plate with protective glass cover for reducing the measuring port to 50 mm Ø
ISP250-270	Cover for the 75 mm measuring port
PS-100	Stabilized power supply 0-16 V, 0-5 A for auxiliary light source



#### Key features at a glance

- Universal for all high-power LEDs, mid-sized LED modules and small lamps
- 500 mm inside diameter, 150 mm measuring port
- Closed and opening version supplied with internal lamp post
- Integrated auxiliary light source to compensate for self-absorption

## ISP 500 – for mid-sized LED modules and more

The ISP 500 has been designed for accurate determination of the radiant power and luminous flux from small lamps, high-power LEDs and mid-sized LED modules. The sphere is supplied in two versions: a closed model for measurements in  $2\pi$  configuration, where light is only input through the side measuring port, and a version that can be opened for carrying out additional measurements in  $4\pi$  configuration.



Opening version of the ISP 500

#### Accessories and options

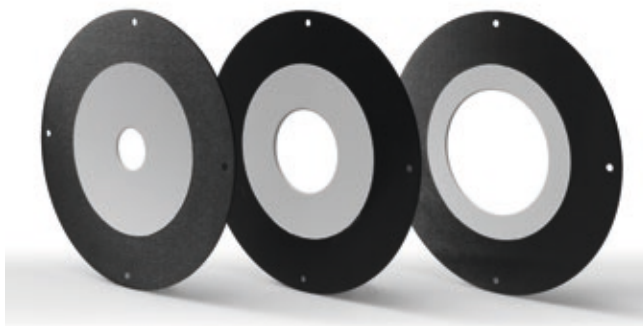
A large number of special adapter plates and test-specimen mounts are supplied for both versions of the ISP 500. The adapter and base plates can be used to connect all LED test sockets and test adapters with TEC temperature control from Instrument Systems easily and reproducibly to the measuring port.



Mount for TEC test adapter LED-850

Universal adapter plates are also supplied as an additional option. These were designed for the measurement of small to mid-sized LED clusters and modules. Several threaded holes are used here to fix the samples in place. Easily interchangeable apertures with diameters

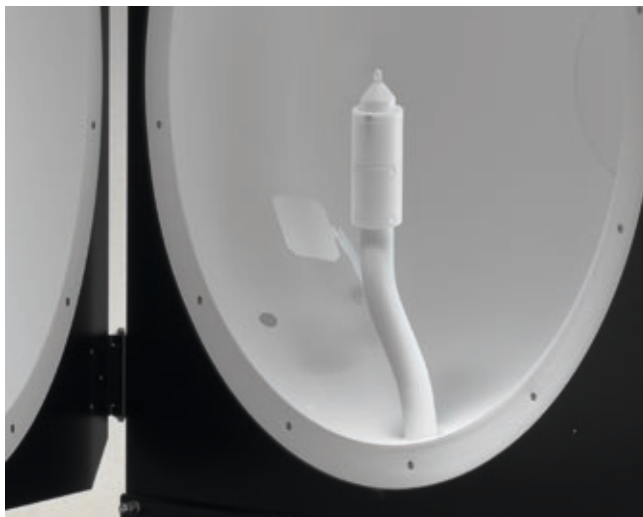
of 25, 50, 75 and 100 mm can be used to adjust the size of the measuring port.



Interchangeable apertures for adjusting the measuring port

### Version for 4 $\pi$ measurements

This version of the ISP 500 can be easily opened with the swivel mechanism. It is fitted with a sample holder in the center of the sphere, which is used to mount the test specimens for measurements in the 4 $\pi$  configuration. Force and sense wires of a four-point measurement procedure are used to supply electricity to the sample and to measure electrical parameters. Terminals are provided on the sample holder which can be easily connected outside the sphere. The sample mount can be configured with a range of standardized plug-in or screw sockets for mounting standardized radial LEDs and lamps. A sample table measuring 100 x 100 mm can also be supplied for secure mounting of samples without standardized sockets. The complete sample holder can be installed in a vertical or suspended position in the integrating sphere.



Internal lamp post in the opened sphere

The ISP 500 is equipped with an integrated auxiliary light source as standard to compensate for self-absorption of the test specimen. A 10 W halogen lamp is used for this purpose.

### Technical specifications

Specification	ISP500-100	ISP500-110
Inside diameter	500 mm	500 mm
Diameter of the measuring port	150 mm	150 mm
Version	Opening version with swivel mechanism	Closed version
Internal sample holder for 4 $\pi$ measurements	Yes	No
Outside dimensions (W, D, H) closed	725 x 608 x 619.5 mm	725 x 608 x 600 mm
Outside dimensions (W, D, H) opened	725 x 715 x 850 mm	
Operating voltage / Power of the auxiliary light source	6 V / 10 W	6 V / 10 W
Weight	19.8 kg	14.5 kg

### Ordering information

Order no.	Description
<b>ISP 500 Integrating sphere</b>	
ISP500-100	Integrating sphere with 500 mm inside diameter; measuring port with 150 mm Ø; opening version, including lamp post in the center of the sphere and halogen auxiliary light source
ISP500-110	Integrating sphere with 500 mm inside diameter; measuring port with 150 mm Ø; closed version; including halogen auxiliary light source
<b>Options</b>	
ISP500-211	Adapter for LED test sockets with 25 mm Ø, incl. aperture set with 7, 10, 15 and 20 mm opening
ISP500-220	Adapter flange for LED test sockets with 50 mm Ø, incl. aperture with 25 mm opening
ISP500-225	Adapter flange for LED-870 TEC test adapter for small LED modules
ISP500-231	Adapter flange to reduce the measuring port to 50 and 25 mm Ø; incl. closing plate
ISP500-233	Adapter flange to reduce the measuring port to 100, 75 and 50 mm Ø; incl. closing plate
ISP500-270	Cover for the 150 mm measuring port
ISP500-300	Adapter for halogen lamps of type G4/GX5.3/G6.35; for assembly on the internal lamp post
ISP500-310	Adapter for radial LEDs with 2.54 mm connecting pins; for assembly on the internal lamp post
ISP500-320	Lamp post for lamps with E27 socket
ISP500-400	Sample table (100 x 100 mm) for fixing test specimens in the center of the sphere; with 4-pole terminal strip for electrical connection
PS-100	Stabilized power supply 0-16 V, 0-5 A for auxiliary light source

**Key features at a glance**

- For large LED modules, lamps and small (SSL) lamps
- 1000 mm inside diameter, 300 mm measuring port
- Optional +/- 90° rotatable version
- Sample platform for fixing LED modules and luminaires
- Lamp post for measuring light sources in a vertical or suspended position
- Integrated temperature sensor and integrated auxiliary light source to compensate for self-absorption

## The ISP 1000 – from high-power LED to SSL lamp

The ISP 1000 has a diameter of one meter. It was specially designed for precise measurement of the radiant power and luminous flux of larger and more powerful light sources for applications in solid state lighting and for lamps in general.

A robust aluminum frame with castors provides efficient handling and stability for opening the sphere. The ISP 1000 is fitted as standard with an integrated halogen auxiliary light source to compensate for the self-absorption of the test specimen and a PT100 temperature sensor in precision class A (IEC751, DIN 43760) to monitor the temperature inside the sphere.

### Sample table

An optional internal sample table is ideal for taking precise measurements of large LED modules. The platform of the sample table measuring 200 x 150 mm is height-adjustable and allows a range of different test objects to be positioned reproducibly and easily at the center of the sphere. An integrated 16-pole terminal strip serves as a convenient interface for power connection and monitoring of the test specimen. An option of supplying the sample table without the terminal strip is available for samples with prefabricated connecting

cables. The connecting cable is routed to the outside through the holder and therefore does not contribute to deviations in measurement due to self-absorption.



Sample table measuring 200 x 150 mm

### Lamp post

A universal lamp post was developed for measurement of the total luminous flux of lamps with standardized plug-in or screw sockets in 4 $\pi$  configuration. This can be installed in a vertical or suspended configuration, and supports electrical four-point measurements of the sample. Instrument Systems offers a comprehensive range of standard test sockets for different sample types which can be easily fixed to the basic unit of the lamp holder.



Lamp post in the suspended position

## Measuring port

The side port with 300 mm diameter for  $2\pi$  measurements can be configured flexibly and quickly for the relevant measurement object. Interchangeable apertures permit easy adjustment of the opening diameter. A series of adapter plates also allows all LED test sockets and TEC test adapters from Instrument Systems to be positioned reliably at the measuring port of the sphere. A further option is provided by a special mount for fixing LED downlights with a wide range of different designs.

## Rotatable version

On request, the ISP 1000 can be supplied as a rotatable version. Supported by a gas-pressure damper, the complete sphere can be rotated easily and safely through  $\pm 90^\circ$ . The measuring port is therefore located on the top or bottom side. Consequently, position-sensitive light sources can be measured in their actual operating position, e.g. in the down-up or up-down configurations.



ISP 1000 in normal and rotatable version

## Technical specifications

Specification	ISP1000-100
Inside diameter	1000 mm
Diameter of the measuring port	300 mm
Outside dimensions (W, D, H) closed	1200 x 1025 x 1790 mm
Outside dimensions (W, D, H), 90° opened	1665 x 1710 x 1790 mm
Outside dimensions (W, D, H), 180° opened	2350 x 845 x 1790 mm
Operating voltage / Power of the auxiliary light source	12 V / 50 W
Temperature sensor / Position	PT100 / Equator plane behind baffle
Weight	approx. 76 kg

## Ordering information

Order no.	Description
<b>ISP 1000 Integrating sphere</b>	
ISP1000-100	Integrating sphere with 1 m inside diameter, including halogen auxiliary light source and temperature sensor; measuring port with 300 mm $\varnothing$
ISP1000-120	Integrating sphere ISP1000-100 in 90° rotatable version
ISP1000-125	Turnkey system for spectral range 280 – 2500 nm, comprises ISP1000-100, ISP1000-301, ISP1000-307 / ISP500-300, ISP1000-400 and fiber bundle (OFG-444-3, PLG-420)
<b>Options</b>	
ISP1000-211	Adapter plate for the 300 mm measuring port with flange for LED test sockets with 25 mm $\varnothing$
ISP1000-220	Adapter plate for the 300 mm measuring port with flange for TEC test adapter with 50 mm $\varnothing$
ISP1000-225	Mounting flange TEC test adapter LED-870
ISP1000-233	Adapter plate for reducing the measuring port to 200, 150, 100 and 50 mm
ISP1000-260	Adapter for downlights with installation at the 300 mm measuring port
ISP1000-301	Internal lamp post in the center of the sphere; suspended or vertical installation possible
ISP1000-307	Adapters for halogen lamps of type G4/GX5.3/G6.35; for fixing at the internal lamp post
ISP1000-310	Adapter for 3 mm T1 and 5 mm T1 $\frac{3}{4}$ LEDs with 2.54 mm connecting pins; for fixing at the internal lamp post
ISP1000-320	Adapter for lamps with E27 socket; for fixing at the internal lamp post
ISP1000-321	Adapter for lamps with E14 socket; for fixing at the internal lamp post
ISP1000-322	Adapter for lamps with E40 socket; for fixing at the internal lamp post
ISP1000-325	Set of adapters for mounting lamps with GU10, G9 and E14 socket at the internal lamp post
ISP1000-400	Height-adjustable sample stage (200 x 150 mm) for fixing samples in the center of the sphere; with 16-pole terminal strip for the electrical connection
ISP1000-402	Height-adjustable sample stage (200 x 150 mm) for fixing samples in the center of the sphere; without cable box and terminal strip for the electrical connections
PS-120	Highly stable switching power supply 0-30 V, 0-10 A for auxiliary light sources





#### Key features at a glance

- Ideal for all types of lamp, luminaires and SSL products
- 1900 mm inside diameter, 600 mm measuring port
- Robust and universal sample table for all types of luminaire and SSL products
- Lamp post for measuring light sources with standard sockets in a vertical and suspended configuration
- Integrated temperature sensor and integrated auxiliary light source to compensate for self-absorption

## The ISP 2000 – large and precise for general lighting

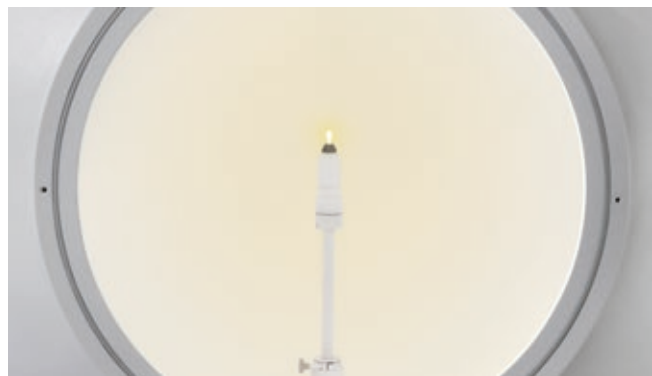
The ISP 2000 was developed for testing large LED modules, Solid State Lighting (SSL) products, and conventional lamps and luminaires. Alongside an auxiliary light source to compensate for self-absorption, it is also equipped with a temperature sensor in precision class A for monitoring the thermal conditions inside the sphere. The entire sphere is located on a stable frame with guide rail which facilitates easy opening of the sphere and therefore fast access to the inside. This device with two locking mechanisms guarantees light-tight closure of the ISP 2000.

### Spectroradiometer and photometer

Like all other integrating spheres in the ISP Series, the ISP 2000 can be used with all spectroradiometers from Instrument Systems. The ISP 2000 furthermore provides a multifunction connector at the detector port, which allows a Class L photometer to be installed instead of the spectrometer. This gives users the option of measuring very fast processes of the test specimen.

### Equipment

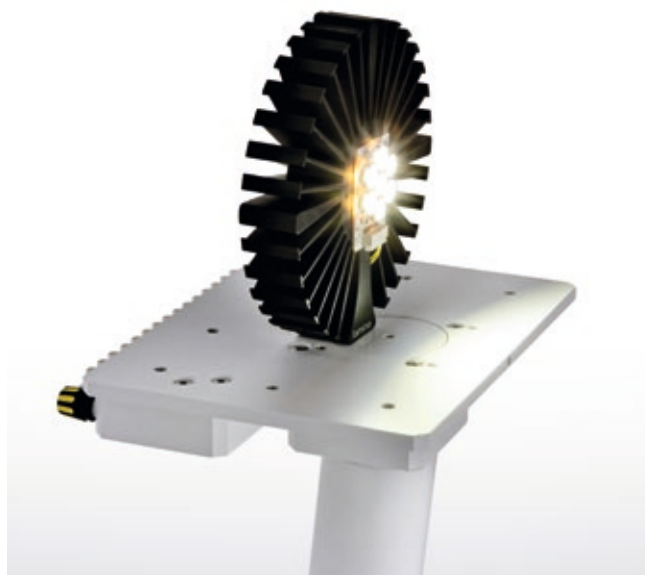
The ISP 2000 is suited for measurements in  $4\pi$ , as well as in  $2\pi$  configuration. The baffles installed in the sphere are manufactured in a way that they protect the detector port against direct irradiation of the luminaire and minimize the impact of interference on the measurement.



Lamp post in vertical position

The comprehensive options for equipment with the ISP 2000 allow users to take a flexible approach to carrying out versatile measuring functions and obtain informative, exceptionally accurate measuring results. A wide

range of sockets and holders is therefore supplied for a variety of different test objects. A universal lamp post was developed for mounting the test specimen inside the sphere and this can be fitted with adapters for many different types of lamp with standard sockets. Power is supplied to the sample and electrical quantities are captured using a four-point measurement. Terminals for this are provided on the lamp post which can be easily connected outside the sphere.



Universal sample table of the ISP 2000

A sample stage can be used instead of the lamp post for mounting non-standardized test specimens, such as complete luminaires and LED modules. This platform offers a base measuring 200 mm x 150 mm with variable height adjustment and a 16-pole terminal strip for controlling and monitoring the test specimen. A version of the sample stage is supplied for test objects with prefabricated connecting cables. The cable is routed to the outside of the sphere through the holding tube of the table. Particularly in the case of dark cables, this leads to a reduction in self-absorption and therefore to a better measuring result.

Instrument Systems also supplies a suitable sample mount for fluorescent tubes with G13 socket. This can be variably adjusted between 44 cm and 150 cm at the holder to match different lengths of the illuminant.



Sample mounts for linear tubes with G13 socket

## Technical specifications

Specification	ISP2000-100
Inside diameter	1900 mm
Diameter of the measuring port	600 mm
Outside dimensions (W, D, H)	2977 x 2010 x 2190 mm
Maximum volume of the sample for 4π measurements	600 x 300 x 300 mm <sup>3</sup>
Operating voltage / Power of the auxiliary light source	12 V / 50 W
Temperature sensor / Position	PT100 / Equator plane behind baffle
Weight	approx. 210 kg

## Ordering information

Order no.	Description
<b>ISP 2000 Integrating sphere</b>	
ISP2000-100	Integrating sphere with 1.9 m inside diameter, including halogen auxiliary light source and temperature sensor; measuring port with 600 mm Ø
ISP2000-125	Turnkey system for spectral range 280 – 2500 nm, comprises ISP2000-100, ISP2000-300, ISP1000-307 / ISP500-300, ISP2000-400 and fiber bundle (OFG-444-3, PLG-420)
<b>Options</b>	
ISP2000-300	Internal lamp post in the center of the sphere, installation possible in a suspended or vertical configuration
ISP2000-400	Height-adjustable sample stage (200 x 150 mm) for mounting samples in the center of the sphere; with 16-pole terminal strip for electrical connection
ISP2000-402	Height-adjustable sample stage (200 x 150 mm) for mounting samples in the center of the sphere; without cable box for terminal strip for the electrical connection
ISP2000-500	Holder for fluorescent tubes of type T8 and T12 with G13 socket; adjustable length of 44 to 150 cm
ISP500-300 / ISP1000-307, -310, -320, -321, -322, -325	All adapters of the ISP 1000 for lamps with standard sockets can be used for fixing to the internal lamp post ISP2000-300.
PS-120	Robust switching power supply 0-30 V, 0-10 A for auxiliary light source



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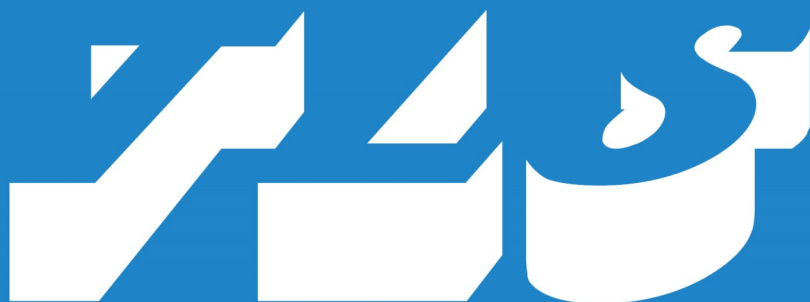
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## TE LINTELO SYSTEMS BV

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light metrology



### Te Lintelo Systems

For more than 30 years Te Lintelo Systems represent prominent suppliers from all over the world for the Benelux countries with well-educated engineers, experience and knowledge. Over the years we became the specialist in the photonics field. Together with our high end suppliers we have the answer for you!

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