

# Newport/Oriel's Custom Solar Simulator



- ; Output beam sizes 2x2", 4x4", 6x6", 8x8", and 12 x 12"
- ; Factory certified Class AAA CW systems
- Calibration certificate validating Class AAA performance for 3 standards
- Long-lived, highly reliable instruments designed specifically for 24/7 production environments, Easy lamp replacement
- Beam direction : upward, downward and sideway configuration

## Product Description

Leveraging over 40 years of experience in light source and power supply design, Newport's Oriel® brand is proud to introduce the latest innovation in solar simulators – the Oriel Sol3A™ Class AAA Solar Simulator family. The product family includes:

All Oriel Sol3A simulators are certified to IEC 60904-9 Edition 2 (2007), JIS C 8912, and ASTM E927-5 standards for Spectral Match, Non-Uniformity of Irradiance, and Temporal Instability of Irradiance. By convention, Class AAA is reported with the first letter representing Spectral performance, the second letter Uniformity of Irradiance, and the third letter Temporal Stability.

The Oriel Sol3A simulators all use a single lamp design to meet not one or two, but all three performance criteria without compromising the 1 Sun output power, providing true Class AAA performance.

The Oriel Sol3A uses a black non-reflective finish to minimize stray light and incorporates captive screws for all panels requiring user access to facilitate lamp replacement, alignment, and filter changes.

Safety interlocks prevent inadvertent exposure to UV light. The Oriel Sol3A rugged design is backed by the Newport Corporation's world wide organization

## **Defining Class AAA Performance Standards**

Photovoltaic standards mandate that Class AAA solar simulators meet demanding requirements in three key performance areas: spectral match to the solar spectrum, spatial non-uniformity of irradiance, and temporal instability of irradiance.

There are three standards that define solar simulator performance.

- IEC 60904-9 Edition 2 (2007) Photovoltaic Devices – Part 9: Solar Simulator Performance Requirements
- JIS C 8912-1998, Solar Simulators for Crystalline Solar Cells and Modules
- ASTM E 927-05 (2005) Specification for Solar Simulation for Terrestrial PV Testing

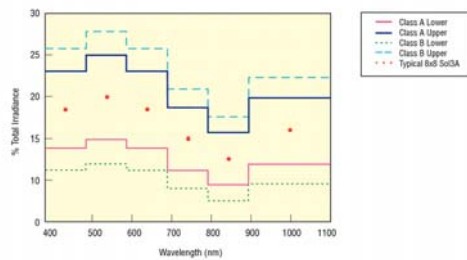
**Table 1 Class AAA Standards and Specifications**

Organization	IEC	JIS	ASTM
Performance Parameter	60904-9-2007	C 8912	E92-05
Spectral Match (fraction of ideal percentage)	0.75 - 1.25	0.75 - 1.25	0.75 - 1.25
Non-Uniformity of Irradiance	2.0%	<±2%	2%
Temporal Instability	0.5% STI <2.0% LTI	<±1%	2%

## Spectral Match

The standards define the spectral match of a solar simulator as a percentage of the integrated intensity in 6 spectral ranges (listed in Table 2). Any deviation from the specified percentages must then lie within a range that determines the class of the simulator. For Class AAA, this range is 0.75 to 1.25 times the ideal percentage.

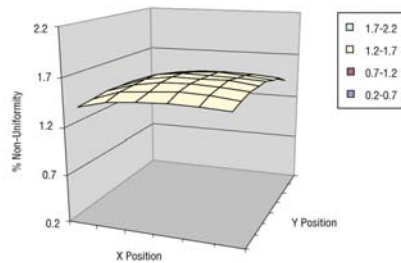
Spectral Range (nm)	Total Irradiance Range (%)	Ideal %
400 - 500	13.9 - 23.1	18.5
500 - 600	15.1 - 25.1	20.1
600 - 700	13.7 - 22.9	18.3
700 - 800	11.1 - 18.5	14.8
800 - 900	9.2 - 15.3	12.2
900 - 1100	12.1 - 20.1	16.1



Sol3A Spectral Match with AM 1.5G spectral correction filter meets IEC, JIS, ASTM Class A requirements to for spectral match.

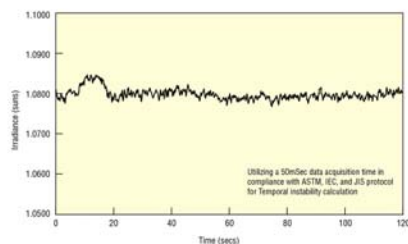
## Spatial Uniformity of Irradiance

The irradiance uniformity over the work area is the most difficult Class AAA requirement to achieve and maintain. Hot spots can lead to significant errors in measured cell efficiency and can cause inaccurate binning of cells. The Class AAA spatial non-uniformity performance standard is designed to minimize the impact of hot spots and has a very stringent requirement of %. The plot below shows the uniformity of the irradiance across a typical simulator working area. Each unit will come with a plot of irradiance non-uniformity.



## Temporal Instability

Temporal Instability is the third performance parameter of Class AAA standards. It requires that the output light be stable over time in order to ensure that the lamp fluctuations do not distort the measurement of solar cell efficiency. Oriel's Sol3A easily meets the requirements for temporal instability as defined by the IEC, ASTM, and JIS standards. The IEC 60904-9 (2007) has the most stringent requirements for short term instability with a maximum allowable level of 0.5%. Figure 4 shows a typical instability response for an Oriel Sol3A utilizing a 50 millisecond data acquisition time.



## Oriel Class AAA Solar Simulator Key Components

### Illuminator Housing

The illuminator housing provides a safe enclosure for the lamp. Its powder coated flat black finish provides a durable surface that also minimizes stray light. It is equipped with safety interlock systems to ensure operator and system safety. Panels containing user serviceable components use captive screws that require no tools for ease of removal and replacement. Integral fan(s) provide forced air-cooling to maintain optimal lamp, optics and housing temperature. The Sol3A housing utilizes a design which allows the head orientation to produce a downward, sideways or upwards facing beam on the 2x2 or 4x4 models. Contact your Sales Engineer for details.

### Integrated Shutter

The Oriel Sol3A Solar Simulator includes an upgraded shutter for production-environment operation. The newly designed shutter for the Class AAA systems is a rugged, single-blade shutter designed for >1 million cycles. Historically, our real-world performance has exceeded 10 million cycles on units in the field for many years. The shutter has a minimum exposure time of 200 ms and can be controlled via a contact closure or logic level input, or a convenient push-button switch on the illuminator housing.

### Xenon Arc Lamp

The Oriel Sol3A Solar Simulator source is a CW system. This enables testing of all cell materials unlike flash-lamp based systems that are limited by the response time of the material allowing the cell to be soaked at a constant light level prior to testing. The lamp is an ozone-free xenon short arc lamp. We certify each source with the supplied lamp. For continuous production environments, we suggest purchasing replacement lamps and an alignment palette to ensure Class AAA compliance as lamps are replaced.

### Air Mass 1.5G Filter

The combination of lamp and air mass filter produces the characteristic Class AAA spectra. Our Air Mass 1.5G Filter retains its optical properties under the conditions encountered without degradation of the filter.

### Power Supply

The Oriel regulated power supply incorporates over 40 years of experience in high voltage power supply design to provide constant electrical power to the xenon lamp. The power supply is CE compliant and features universal AC mains operation for use anywhere in the world. Lamp usage can be monitored in accumulated hours from the power supply, because it is important to replace the lamp at the end of its rated life to maintain the minimum 1 sun output and spectral characteristics. The lamp's output will significantly decrease and change spectrally with continued use beyond its rated life.

### Maintaining the Oriel Sol3A Solar Simulator

Oriel Sol3A Solar Simulators maintain Class AAA compliance during the rated "performance lifetime" of the lamp. When the lamp is replaced, the instrument should be realigned to maintain Class AAA compliance. Irradiance uniformity is the most difficult Class AAA requirement to meet and maintain. In order to facilitate the measurements and adjustments necessary to maintain Class A uniformity, the Newport uniformity measurement tool (SOL-UMT) can be used to perform an automated test after lamp alignment following installation or replacement. The use of this tool can significantly reduce the time and effort required to maintain the Sol3A Solar Simulator within Class AAA specifications. \* Please contact a Sales Engineer for details.

\*Note: the use of these tools does not constitute re-certification of the system to Class A standards. For re-certification the entire Sol3A solar simulator must be returned to the factory. We recommend purchasing replacement lamps and certification at the time of purchase of the source. Contact a Sales Engineer for details.

### Extended Care Program

All Oriel® Solar Simulators are shipped with a one-year warranty on parts and labor. We now offer an extended care plan, which gives you coverage for two years. Please ask a Sales Engineer about this plan, when placing your order.

### **Safety Considerations**

These illuminators produce considerable ultraviolet radiation. Exposure to intense UV radiation can cause delayed severe burns to the eyes and skin. Proper protective eyewear and gloves should be worn at all times during operation.

### **Specifications**

Wattage	450 ~1600 W
Lamp Type	Xenon, Short Arc
Output Beam Size	2 x 2 in (50 x 50 mm) to 12 x 12 in (300 x 300 mm)
Collimation	<±1~4°
Beam Uniformity	<2 %
Light Ripple	<1 % rms
Solar Simulator Input	95 - 264 VAC, 8 A, 47 - 63 Hz
Line Regulation	0.01 %

### **Ordering Information**

Model	Description	Beam Direction
SP94023A-SR1	450 W, 2 x 2 in. Collimated Output, Class AAA	Upward
SP94023A-SR3	450 W, 2 x 2 in. Collimated Output, Class AAA	Sideway
SP94043A-SR1	450 W, 4 x 4 in. Collimated Output, Class AAA	Upward
SP94043A-SR3	450 W, 4 x 4 in. Collimated Output, Class AAA	Sideway

To other beam configuration, the part number will be SP940xxA-SRx