PART 90113411. REV B- 3/12/25

User Manual

ORIEL® SOLARIS

CLASS A+AA SOLAR SIMULATOR

1791 Deere Avenue
IRVINE, CA 92606
(800) 222.6440 OR (877) 825.9620

FAX: (945) 253.1680
E-MAIL: SALESIRV@MKS.COM
WWW.MKSINST.COM

Table of Contents

List of Figures and Tables

1 Warranty

If there are any defects in material or workmanship or a failure to meet specifications, notify Newport promptly, prior to the expiration of the warranty.

Except as otherwise expressly stated in Newport's quote or in the current operating manual or other written guarantee for any of the Products, Newport warrants that, for the period of time set forth below with respect to each Product or component type (the "Warranty Period"), the Products sold hereunder will be free from defects in material and workmanship, and will conform to the applicable specifications, under normal use and service when correctly installed and maintained. Newport shall repair or replace, at Newport's sole option, any defective or nonconforming Product or part thereof which is returned at Buyer's expense to Newport facility, provided, that Buyer notifies Newport in writing promptly after discovery of the defect or nonconformity and within the Warranty Period. Products may only be returned by Buyer when accompanied by a return material authorization number ("RMA number") issued by Newport, with freight prepaid by Buyer. Newport shall not be responsible for any damage occurring in transit or obligated to accept Products returned for warranty repair without an RMA number. Buyer bears all risk of loss or damage to the Products until delivery at Newport's facility. Newport shall pay for shipment back to Buyer for Products repaired under warranty.

WARRANTY PERIOD

All Products (except consumables such as lamps, filters, etc.) described here are warranted for a period of twelve (12) months from the date of shipment or 3000 hours of operation, whichever comes first.

Lamps, gratings, optical filters and other consumables / spare parts (whether sold as separate Products or constituting components of other Products) are warranted for a period of ninety (90) days from the date of shipment.

WARRANTY EXCLUSIONS

The above warranty does not apply to Products which are (a) repaired, modified or altered by any party other than Newport; (b) used in conjunction with equipment not provided or authorized by Newport; (c) subjected to unusual physical, thermal, or electrical stress, improper installation, misuse, abuse, accident or negligence in use, storage, transportation or handling, alteration, or tampering, or (d) considered a consumable item or an item requiring repair or replacement due to normal wear and tear.

DISCLAIMER OF WARRANTIES; EXCLUSIVE REMEDY

THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES. EXCEPT AS EXPRESSLY PROVIDED HEREIN, NEWPORT MAKES NO WARRANTIES, EITHER EXPRESS OR IMPLIED, EITHER IN FACT OR BY OPERATION OF LAW, STATUTORY OR OTHERWISE, REGARDING THE PRODUCTS, SOFTWARE OR SERVICES. NEWPORT EXPRESSLY DISCLAIMS ANY IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE FOR THE PRODUCTS, SOFTWARE OR SERVICES. THE OBLIGATIONS OF NEWPORT SET FORTH IN THIS SECTION SHALL BE NEWPORT'S SOLE LIABILITY, AND BUYER'S SOLE REMEDY, FOR BREACH OF THE FOREGOING WARRANTY. Representations and warranties made by any person including distributors, dealers, and

representatives of Oriel / Newport which are inconsistent or in conflict with the terms of this warranty shall not be binding on Newport unless reduced to writing and approved by an expressly an authorized officer of Newport.

2 Safety Information

2.1 Safety Procedures and Precautions

The following general safety precautions must be observed during all phases of operation of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of intended use of the instrument and may impair the protection provided by the equipment. MKS Instruments, Inc. assumes no liability for the customer's failure to comply with these requirements.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT

Do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to an MKS Calibration and Service Center for service and repair to ensure that all safety features are maintained.

SERVICE BY QUALIFIED PERSONNEL ONLY

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel only.

ELECTRICAL HAZARDS

The power supply provides voltages and currents that can be **lethal**. The power supply should only be operated with MKS provided cables that are properly secured to both the power supply and the lamp housing.

A transient ignition pulse of several kilovolts is used to start the lamp. Do not attempt circumvent the interlocks on the lamp housing door or operate with any panels removed.

ULTAVIOLET RADIATION HAZARDS

This unit produces high intensity ultraviolet (UV) radiation. This radiation can cause severe burns to skin and the outer layers of the eye which may not become apparent for hours or even days after exposure. As with sunlight there is a risk of melanoma (skin cancer) as well as the formation of cataracts with repeated exposure.

Under normal operating conditions, the user receives minimal UV exposure even over long periods of operation. However, certain precautions should always be taken when operating this equipment:

- Always avoid exposure to the direct, reflected, or diffuse radiation from the lamp or the unit itself.
- Always wear UV-blocking glasses, goggles, or other face shielding during operation.
- Always wear protective clothing and gloves if it is necessary to be exposed to the direct beam, even if only for a few seconds.

For a list of Newport-recommended UV protection solutions, please refer to Table 9.

OZONE

Ultraviolet light reacts on a molecular level with the atmosphere to produce ozone that is vented from the housing during normal operation by the cooling fans. Fortunately, the lamps used in the Solaris products are designed to block most of the wavelengths of light that produce Ozone.

Ozone is considered toxic and can induce headaches, nausea, and flu-like symptoms. For people with chronic respiratory conditions such as asthma, extremely high levels of ozone can pose a serious health hazard. Susceptibility varies significantly from individual to individual.

Fortunately, ozone has a distinctive odor. If this smell is noticed persistently in an area remote from the fans, it is recommended to check the ozone levels with a test kit and improve the ventilation of the area.

LAMP HAZARDS

The arc lamps used in this product are filled with rare gas at high pressure. There is always a danger of lamp explosion due to mechanical failure. This is particularly true when the lamp is operating since the internal pressure can reach tens of atmospheres. Thermal strains can cause the lamp to explode under certain conditions.

- **Never touch the lamp with bare fingers or other contaminants**. Skin oil or other substances can burn into the lamp envelope and weaken its structure.
- Always wear appropriate gloves and impact-resistant goggles when handling the lamp.
- Avoid any mechanical strain during handling.
- DO NOT operate the lamp unless all housing panels are in place.
- Arc lamps become very hot (up to 220°C) after only a few minutes of operation and remain quite hot for at least 25-30 minutes after being turned off.
- If the Arc Lamp is turned off, do not attempt to restart the lamp until the lamp has completely cooled. Lamp life may be significantly reduced by failure to adequately cool it.

ELECTROMAGNETIC INTERFERENCE (EMI)

Ignition of an arc lamp requires a high voltage pulse. This pulse generated is a source of EMI - both radiated and conducted. Good grounding, cable routing practice, and EMI shielding may be necessary to protect sensitive circuitry from this ignition pulse.

It is suggested to start the arc lamp before powering up nearby computer equipment. Keep computers and other sensitive electronic devices at least six feet (1.8 meters) away from the light source.

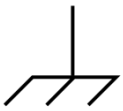
2.2 Symbols Used in This Instruction Manual

Definitions of, NOTE, CAUTION, WARNING and DANGER messages used throughout the manual.

NOTE	**The NOTE sign denotes important information. It calls attention to a procedure, practice, condition, or the like, which is essential to highlight.**
CAUTION	**The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of all or part of the product.**
WARNING	**The WARNING sign denotes a hazard. It calls attention to a procedure, practice, condition, on the like, which, if not correctly performed or adhered to, could result in injury to personnel.**
DANGER	**The DANGER sign Indicates an imminently hazardous situation that, if not avoided, will result in death or serious injury.**

2.3 Symbols Found on the Unit

The following table describes symbols that may be found on the unit.

ON (Supply) IEC 417, No. 5007	 OFF (Supply) IEC 417, No. 5008	 Caution refers to accompanying documents ISO 3864, No. B.3 1	 Caution hot surface IEC 417, No. 5021
 UV Light Hazard ISO 3864, No. B.3 17	 Caution risk of electric shock ISO 3864, No. B.3 6	 Protective earth (ground) IEC 417, No. 5019	 Frame or Chassis IEC 417, No. 5020

3 Features and Specifications

3.1 Components included

Each System Includes:

- Lamp housing with a built-in arc lamp igniter.
- An arc lamp power supply (69920 for 450W and 1kW lamps and 69922 for 1.6kW lamps).
- An arc lamp.
- Heat Sink.
- Lamp Socket Adaptor (attached to lamp).
- All necessary adapters and cables.
- Air mass filter(s) in black case.
- AC Line Cords (2) correct for the AC main in the destination country.

NOTE **Do not discard any packing materials unless you have completed your inspection and are sure the unit arrived safely.**

3.2 Specifications and Certifications

Performance Specifications					
Parameter	**Solaris-2**	**Solaris-4**	**Solaris-6**	**Solaris-8**	**Solaris-12**
Nominal Lamp Electrical Power[1]	450 W	450 W	1000 W	1600 W	1600 W
Illumination Area	2 x 2 in [50 x 50 mm]	4 x 4 in [100 x 100 mm]	6 x 6 in [150 x 150 mm]	8 x 8 in [200 x 200 mm]	12x12 in [300 x 300 mm]
Maximum Angle of Incidence	±4°	±4°	±3°	±2°	±1.5°
Nominal Working Distance	12 in [300 mm]	6 in [150 mm]	7 in [180 mm]	15 in [380 mm]	12 in [300 mm]
Typical Output Power	100 mW / cm^2 (1 SUN)				

Table 1: Performance Specifications

General Specifications					
Parameter	**Solaris-2**	**Solaris-4**	**Solaris-6**	**Solaris-8**	**Solaris-12**
Weight	65 lbs [29.5 kg]	70 lbs [32 kg]	75 lbs [34 kg]	130 lbs [59 kg]	135 lbs [61 kg]
Dimensions H x W X D (not including risers)	19.9 x 18.7 x 9.5 in [507 x 474 x 241 mm]	19.0 x 29.8 x 12.8 in [483 x 758 x 324 mm]	19.0 x 35.5 x 12.8 in [483 x 901 x 324 mm]	20.4 x 38.3 x 15.5 in [518 x 974 x 394 mm]	24.6 x 38.0 x 15.5 in [624 x 966 x 394 mm]
Operating Temperature Range	20°C to 30°C				
Storage Temperature Range	-40°C to 70°C				
Humidity	< 45%, relative, non-condensing				
Input Power Required for lamp housing	120-250 VAC, 1A, 50/60 Hz	120-250 VAC, 1A, 50/60 Hz	120-250 VAC, 1A, 50/60 Hz	120-250 VAC, 1A, 50/60 Hz	120-250 VAC, 1A, 50/60 Hz
Input power for Power supply	95-132 VAC, 15A / 190-264 VAC, 7.5A 50/60 Hz	95-132 VAC, 15A / 190-264 VAC, 7.5A 50/60 Hz	190-264 VAC, 12A 50/60 Hz	190-264 VAC, 12A 50/60 Hz	190-264 VAC, 12A 50/60 Hz

Table 2: General Specifications

Certifications	
Spectral Irradiance scan[2]	250 – 1700 nm at 1 SUN without a filter installed and subsequent scan with the AM 1.5G+ filter installed
Spectral Match Classification	A+ – IEC 60904-9:2020
Uniformity Classification	A – IEC 60904-9:2020
Temporal Stability Classification	A – IEC 60904-9:2020

Table 3: Certifications

FOOTNOTES

1. *± 20% adjustable power from lamp rated power without adverse performance via power supply.*
2. *Provided with the test data on the USB thumb drive.*

Newport-Oriel Instruments
Ave. Libre Comercio Esquina con
Calzada Industrial No. 1
Parque Industrial Nuevo Nogales
Nogales, Sonora. México. 84094

www.newport.com/b/oriel-instruments

PERFORMANCE VALIDATION CERTIFICATE
ORIEL® SOLAR SIMULATOR

MODEL: XXX SERIAL#:XXX
LAMP MODEL: XXX SERIAL#: XXX

MEETS OR EXCEEDS CLASS XXX FOR:

SPECTRAL MATCH
NON-UNIFORMITY OF IRRADIANCE
TEMPORAL INSTABILITY OF IRRADIANCE

Performance validation of Spectral Match:
The current system is within the acceptable limits of Class ____ spectral match.

Performance validation of Non-Uniformity of irradiance:
Verified over the ____ working area.
IEC non-uniformity of irradiance of this system is ____%.

Performance validation of Temporal Instability of irradiance:
The IEC short-term temporal instability of irradiance of this system is _____%.
The IEC long-term temporal instability of irradiance of this system is _____%.

Spectral Coverage and Spectral deviation:
IEC AM1.5 Spectral Coverage is _____%.
IEC AM1.5 Spectral Deviation is _____%.

UNDER ALL OF THE FOLLOWING STANDARDS:

1. IEC 60904-9 Ed.3 (2020) Photovoltaic devices - Part 9: Classification of solar simulator characteristics
2. ASTM E927-19: Standard Classification for Solar Simulators for Electrical performance Testing of Photovoltaic Devices
3. JIS 8904-9 (2017): Solar simulators for crystalline solar cells and modules

All measurements were performed at an irradiance of 1 SUN at a working distance of _____ inches and a lamp power of _____ Watts. The total lamp hours are _____.

Verified by:

_____ **Date**: _____

Figure 1: Performance Validation Certificate for Oriel® Solaris.

4 Setting up the system

4.1 Unpacking the system

Remove all items from the shipping containers and verify that the primary items as well as any optional accessories that you ordered are accounted for by cross-checking the contents against the packing slip.

Be sure to retain all packing materials for shipment of the product back to the company for service and/or recertification.

Each system includes:

- Illuminator housing with a built-in arc lamp ignitor.
- Arc lamp power supply.
- Arc lamp.
- Heat sink.
- Lamp socket adaptor.
- All necessary adapters and cables.
- Air mass filter in black case.
- AC Line Cords (2) correct for the AC main in the destination country.
- Check to ensure the serial number on the lamp box matches the serial number reported on the certificate. If multiple lamps have been purchased, all may have the same referenced model number but should have unique serial numbers. Note that only one lamp was used to certify the simulator by the factory.

NOTE **If any items are missing or damaged, contact your Newport sales representative immediately.**

Figure 2: Lamp and heat sink (pith packing crate)

Figure 3: Air mass filter assembly (stored in case)

Figure 4: Unpacked components.

Figure 5: Simulator and power supply unpacked.

4.2 Mounting the System

CAUTION **When removing the Solaris from the crate be careful when placing it on a surface as it has a center of gravity towards the output lens and can easily tip. Be certain to support the unit until it is permanently mounted to a work surface.**

See Appendix A for dimensional drawings to determine how your Solaris solar simulator will be mounted to accommodate your test fixture.

NOTE **The following models come with risers from the factory due to their working distances.**

Riser Assemblies	
Model	**Riser Part Number**
Solaris-2	90026519
Solaris-6	603873
Solaris-8	90023002

Table 4: Riser Assemblies

Figure 6: Risers for models Solaris 2 and Solaris 8, respectively.

See Table 1 for required working distances to achieve Class A uniformity.

WARNING **When setting up and the solar simulator you must:**
Wear eye protection,
Wear gloves,
Cover all exposed skin,

Make sure the housing and power supply are unplugged from the AC mains.

It is recommended that the Solar Simulator be mounted to an optical table or breadboard. The following table provides a few Newport mounting solutions for each model:

Newport Breadboard Mount Solutions				
Model	**Base Plate Dimensions**	**Breadboard Solution**	**Full Length Dimensions**	**Breadboard solution**
Solaris-2	12.75” x 12.31”	SA2-18X18	25.4” x 12.75”	SA2-18X30
Solaris-4	12.75” x 12.31”	SA2-18X18	26.9” x 12.75”	Sa2-18x30
Solaris-6	12.75” x 12.31”	SA2-18X18	32.5” x 12.75”	SA2-18X36
Solaris-8	20.0” x 15.5”	SA2-18X24	35.2” x 15.5”	SA2-18X36
Solaris-12	23.25” x 21.75”	SA2-22	37.0” x 21.75”	SA2-24

Table 5: Newport Breadboard Mount Solutions

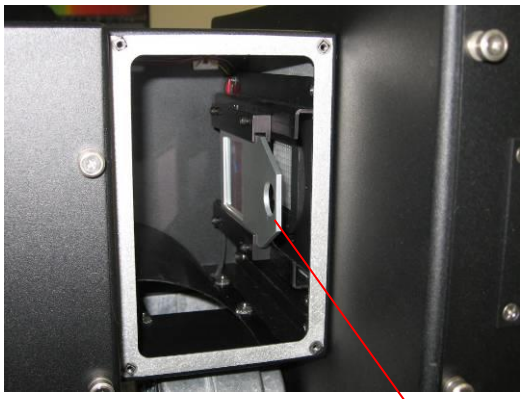
4.3 Installing Filters

Remove the side cover of the output assembly to inspect the lens, mirror, and front surface of the beam homogenizer for shipping damage as shown in Photo 10. If any optical surface requires cleaning, refer to section 6.3 Cleaning Optics in this manual for more details.

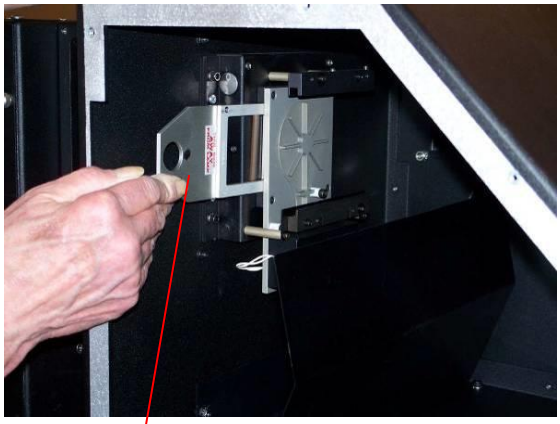
Solar simulators include **spectral correction filters (Air Mass filters)**, which correct the light output to closely match the solar spectrum under varying conditions. This section discusses these filters and how to properly install them in your unit. Most SOLARIS simulators include an **AM1.5G+ Filter** standard with the system as shown below. The filter is shipped in its own case. Note that the solar simulator should never be transported with the filter in place. Save this case for storage of the filter. A label indicates which side must face away from the lamp.

To install the filter for the 6x6, 8x8, and 12x12 models, remove the partial SUN attenuator panel, insert the filter as shown below, and secure the partial SUN attenuator panel back with the knob turned to maximum in the clock-wise direction (this corresponds to the partial SUN attenuator being fully open).

To install the filter for the 2x2 and 4x4 models, remove the lens housing side cover, insert the filter as shown below, and secure the lens housing side cover back into position.



Filter installed 6x6, 8x8 and 12x12 models



Filter installed 2x2 and 4x4 models

Air mass 1.5G filter installed **here** for 6x6, 8x8 and 12x12 models

Air mass 1.5G filter installed **here** for 2x2 and 4x4 models

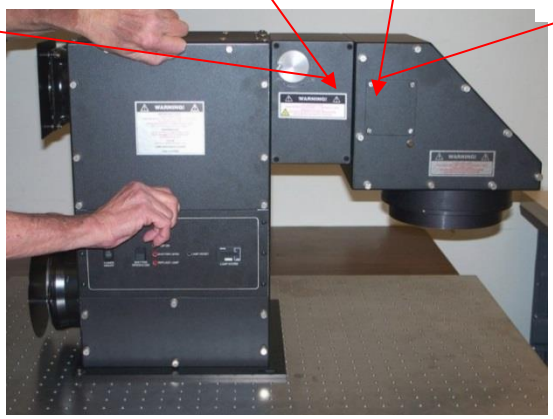


Figure 7: Proper installation placement of air mass filters for various models

Figure 8: Output assembly, side cover removed.

Alternate Air Mass Filters can be installed in the SOLARIS series to simulate conditions other than AM1.5G.

Alternative Air Mass Filters		
Air Mass Filter Type	**Function**	Model Number
AM 0	Corrects the output of a xenon lamp to better match the solar spectrum found outside the earth's atmosphere	81311
AM 1.5 Direct	Simulates the direct solar spectrum when the SUN is at a zenith angle of 37.0^0 (ASTM E891).	81389

Table 6: Air Mass Filters

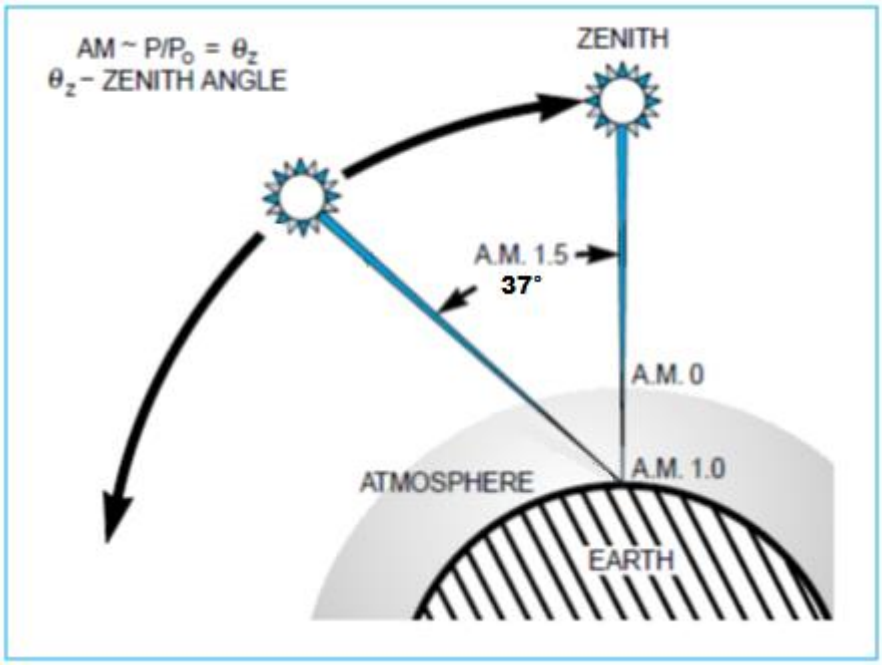


Figure 9: Air Mass Filters: AM0 (2”x2”), AM1.5D filters (2”x2”)

4.4 Operation Guide for Partial SUN Attenuator

Oriel Solaris solar simulators come with a partial SUN attenuator already installed in the system. The partial SUN attenuator assists in manual control of the irradiance level without compromising Class A+ spectral match of the system.

As shown in the red circle, the partial SUN attenuator fits in the middle section of class 3A solar simulator housings.

Follow the steps below to remove the Partial SUN Attenuator:

1. Remove the middle section side panel as shown above. *(Pictures and diagrams below are for demonstration purpose only, actual size and shape of solar simulator varies by beam size and model number)*
2. To ensure proper installation rotate the knob fully in either direction.
3. The label under the knob indicates that if the knob is turned in a clockwise direction, the output irradiance increases, and if turned in a counterclockwise direction, the output irradiance decreases.
4. To use the partial SUN attenuator, adjust the knob in either direction to attain the desired irradiance level when the solar simulator is turned on. *(Note: In order to verify the desired irradiance level has been reached, a calibrated reference cell or any irradiance measuring device should be used. Relying on the number of turns or the knob orientation for any*

particular level of irradiance will not guarantee repetitive results.)

SAMPLE DATA OF % CHANGE IN NON-UNIFORMITY MEASURED ON A SOLARIS 12 SOLAR SIMULATOR

Partial SUN Attenuator Effects on Beam Uniformity	
Conditions	**Non-uniformity %**
Normal 1SUN – no partial SUN module installed	1.33
Fully/Max open 1SUN - with partial SUN module installed	1.25
0.75 SUN - with partial SUN module installed	1.80
0.50 SUN - with partial SUN module installed	2.40
0.25 SUN - with partial SUN module installed	3.97
Fully/Min closed 0.11 SUN - with partial SUN module installed	5.35

Table 7: Partial SUN attenuator effects on Beam Uniformity

NOTE ***As the irradiance level is decreased using the partial SUN attenuator, % non-uniformity tends to deteriorate. Data shown in table above is a sample set of data acquired on a Solaris 12 solar simulator to approximate the change in % non-uniformity. Actual non-uniformity due to the partial SUN attenuator may slightly vary among different solar simulators and with solar simulators of different beam sizes.***

4.5 Lamp Access / Removing Panels

Remove the top side cover of the lamp housing, which is referred to as the lamp access panel, by unscrewing all the panel screws and lifting the panel from the housing. Carefully inspect the ellipsoidal reflector, primary mirror, and rear surface of the beam homogenizer for any damage that may have been caused during shipping. If any optical surface requires cleaning, refer to section 6.3 Cleaning Optics in this manual for more details.

Figure 10: Removing the lamp access panel.

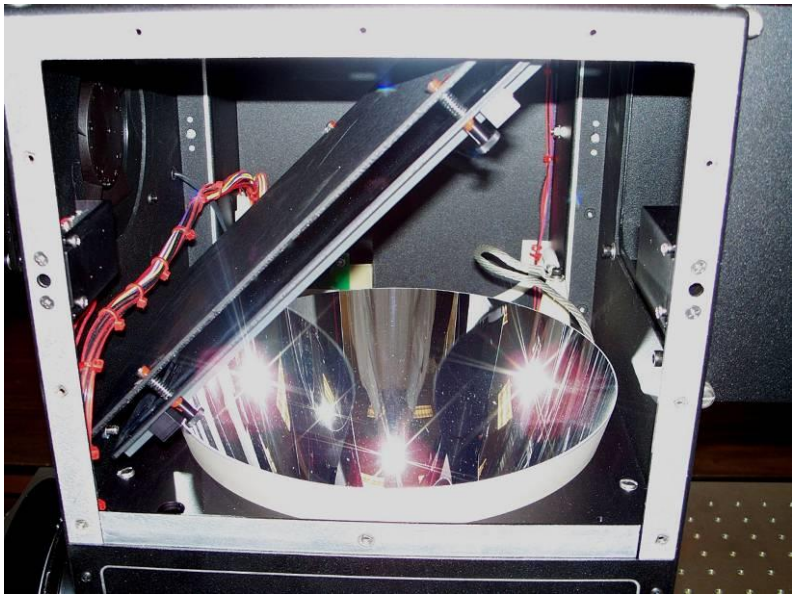


Figure 11: Lamp access panel removed.

4.6 Installing the Lamp

4.6.1 Installing the 450W Lamp

WARNING	**Always wear appropriate gloves and impact-resistant goggles when handling the lamp. Refer to Table 9 for a list of Newport-recommended options.**
CAUTION	**Avoid undue stress on the glass portion of the lamp (protecting both the seals and envelope) to minimize the chance of catastrophic lamp failure. Use only your fingers when the lamp is held at one end, and you are exerting a force on the other end.**
CAUTION	**Lamp orientation is critical. Xenon lamps are designed to operate with the anode (+) end pointing upwards.**

1. Locate the 450W Heat Sink Assembly (PN 90023031) consisting of the brass lamp threaded adapter (PN 8071-2-1005-2) and heat sink (PN 90015859).
2. Remove the lamp from its container and check to make sure that the envelope is clean (if necessary, clean it using denatured alcohol and lint-free tissues).

NOTE	**If your lamp has a "starter" wire in place; do not remove it from the lamp.**

3. Place the brass threaded adapter on the cathode of the lamp (- endcap). Tighten the set screws to secure it in place.
4. Place the heat sink over the exposed + endcap, ensuring that the endcap inserts fully into the heat sink. Tighten the two #10-32 set screws with the provided hex wrench to secure the heat sink to the lamp.
5. Hold the lamp by the heat sink and place the threaded end through the ellipse into the socket. Screw the lamp into the socket, being careful not to over tighten. **Use fingers only** – **DO NOT use any tool to tighten the lamp in the socket** as this could over stress the envelope and seals, resulting in catastrophic lamp failure.

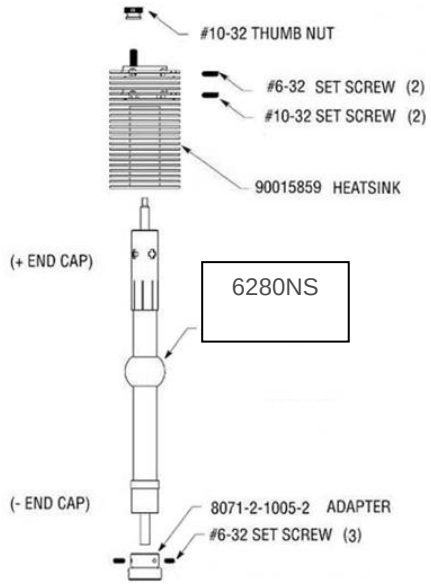


Figure 12: Installing the 450W Lamp

Figure 13: 450W Lamp with heat sink attached

4.6.2 Installing the 1.0kW Lamp

WARNING	**Always wear appropriate gloves and impact-resistant goggles when handling the lamp. Refer to Table 9 for a list of Newport-recommended options.**
CAUTION	**Avoid undue stress on the glass portion of the lamp (protecting both the seals and envelope) to minimize the chance of catastrophic lamp failure. Use only your fingers when the lamp is held at one end, and you are exerting a force on the other end.**
CAUTION	**Lamp orientation is critical. Xenon lamps are designed to operate with the anode (+) end pointing upwards.**

1. Locate the 1.0kW Heat Sink Assembly (PN 90023032) consisting of the brass lamp threaded adapter (PN 8071-2-1005-1), and heat sink (PN 90026578).
2. Remove the lamp from its container and check that the envelope is clean (if necessary, clean it using denatured alcohol and lint-free tissues).

NOTE	**If your lamp has a "starter" wire in place; do not remove it from the lamp.**

3. Place the brass threaded adapter on the cathode of the lamp (- endcap). Tighten the #6-32 set screws to secure the adapter to the lamp.

4. Place the heat sink over the exposed + endcap, ensuring that the endcap inserts fully into the heat sink. Tighten the #6-32 socket head cap screw to secure the heat sink to the lamp.
5. Hold the lamp by the heat sink and place the threaded end through the ellipse and into the socket. Screw the lamp into the socket, being careful not to over tighten. **Use fingers only - do not use any tool to tighten the lamp in the socket** as this could over stress the envelope and seals, resulting in catastrophic lamp failure.

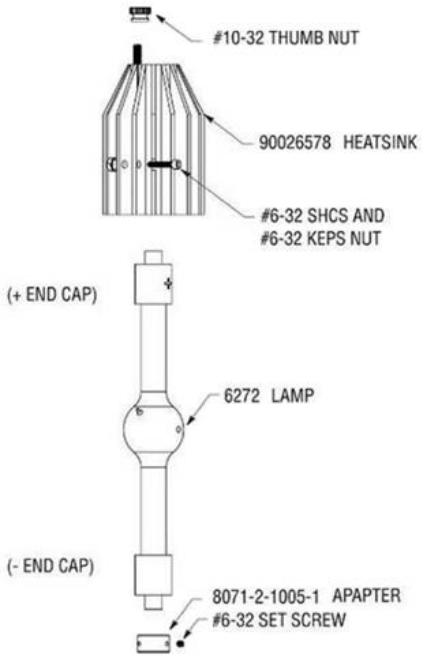


Figure 14: Lamp Assembly for 1kW Lamp

Figure 15: 1kW lamp with heat sink attached

4.6.3 Installing the 1.6 kW Lamp

WARNING	**Always wear appropriate gloves and impact-resistant goggles when handling the lamp. Refer to Table 9 for a list of Newport-recommended options.**
CAUTION	**Avoid undue stress on the glass portion of the lamp (protecting both the seals and envelope) to minimize the chance of catastrophic lamp failure. Use only your fingers when the lamp is held at one end, and you are exerting a force on the other end.**
CAUTION	**Lamp orientation is critical. Xenon lamps are designed to operate with the anode (+) end pointing upwards.**

1. Locate the 1.6kW Heat Sink Assembly (PN 90026576) consisting of the brass lamp threaded adapter (PN 8071-2-1005-1) and heat sink (PN 90026577).

2. Remove the lamp from its container and check that the envelope is clean (if necessary, clean it using denatured alcohol and lint-free tissues).

NOTE **If your lamp has a "starter" wire in place; do not remove it from the lamp.**

3. Place the brass threaded adapter on the cathode of the lamp (- endcap). Tighten the #6-32 set screws to secure the adapter to the lamp.
4. Place the heat sink over the exposed + endcap, ensuring that the endcap inserts fully into the heat sink. Tighten the #6-32 socket head cap screw to secure the heat sink to the lamp.
5. Hold the lamp by the heat sink and place the threaded end through the ellipse and into the socket. Screw the lamp into the socket, being careful not to over tighten. **Use fingers only - do not use any tool to tighten the lamp in the socket** as this could over stress the envelope and seals, resulting in catastrophic lamp failure.

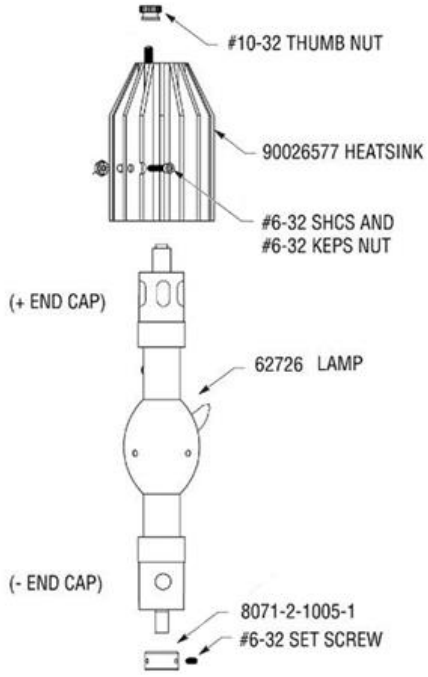


Figure 16: Installing the 1.6kW Lamp

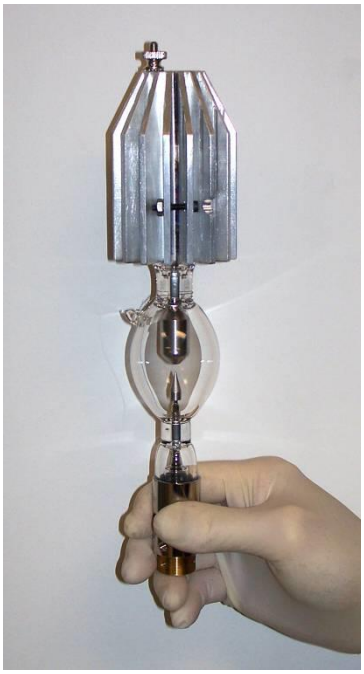


Figure 17: 1.6kW lamp with heat sink attached

4.7 Electrical Connections

There are two cables that connect the 69920 / 69922 power supply to the illuminator housing. One cable has a **black** connector on each end **(70050)** while the other has a **gray** connector on each end

(70051). The receptacles for these connectors are marked on both the power supply and the housing.

Make sure the connectors are firmly seated and that the jack screws are finger tight.

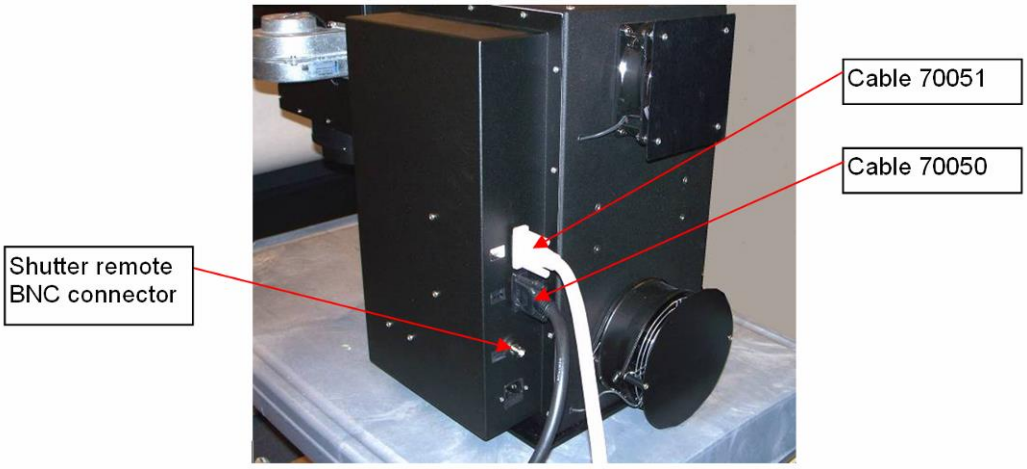


Figure 18: Electrical connections on simulator (black and gray cables)

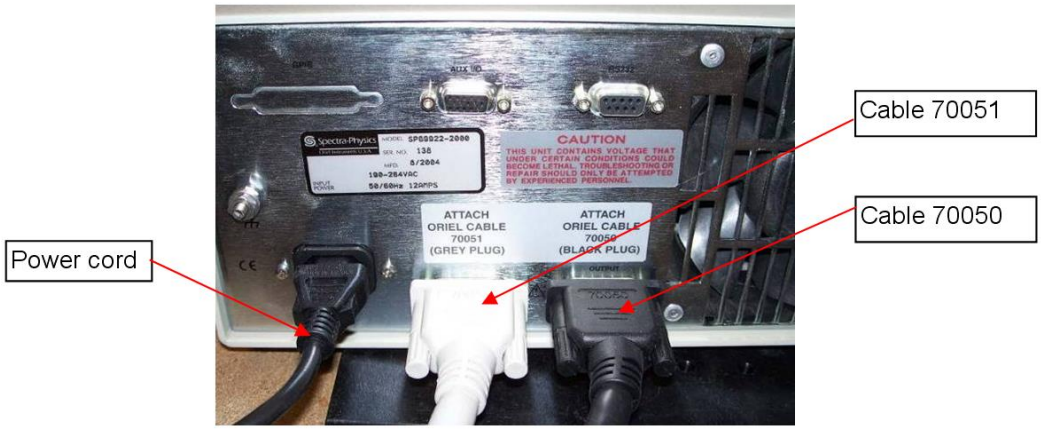


Figure 19: Electrical connections on power supply (black and gray cables)

The BNC connector on the housing labeled “SHUTTER REMOTE” is the connection to be used for the optional hand-held foot switch shutter controller, or the optional digital controller. If a **Digital Exposure System** is in the system, please refer to the Digital Exposure System Manual found on the Newport website for set-up instructions.

The remaining connector on the housing is for the AC line cord. The AC input is universal (it auto senses the input voltage so no configuration is required for line voltages within the specification limits) and will operate between 95-265VAC and 47-63Hz.

CAUTION **Avoid using an external power switch or breaker to power off the solar simulator since the fans require AC voltage to complete their 10-minute cool down of the lamp after power switch is turned off.**

4.8 Lamp Housing Controls

Take a few minutes to familiarize yourself with the illuminator housing control panel.

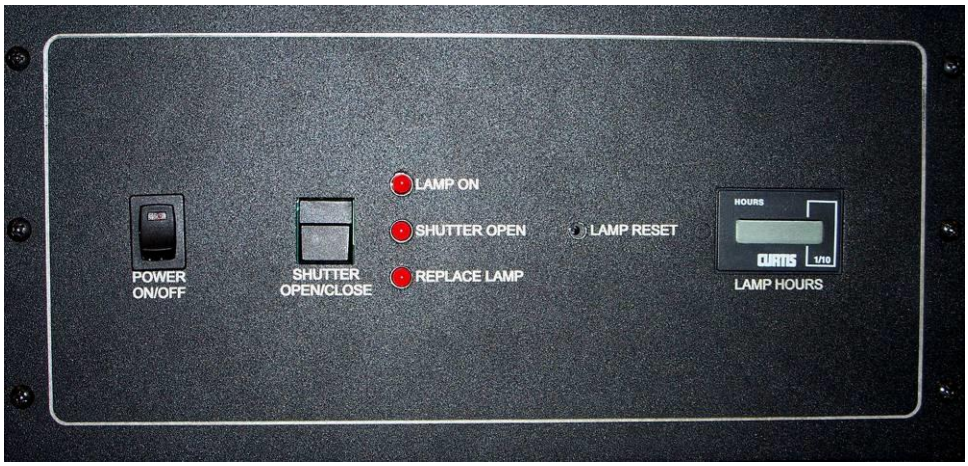


Figure 20: The illuminator housing control panel.

The **POWER ON/OFF** button energizes the illuminator control panel, providing power to activate the shutter. Even when this switch is OFF, there may be hazardous voltages present in the REAR compartment of the illuminator. This area is not accessible under normal use and presents no hazard to the operator.

The **SHUTTER OPEN/CLOSE** switch manually activates the shutter. This button replicates the function of the optional hand-held or foot-activated remote switch.

NOTE **If the front panel shutter switch is depressed, the remote input will have no effect. Similarly, if the remote input is active (TTL high), the front panel shutter switch has no effect.**

The **LAMP HOURS meter (ETI)** indicates the cumulative lamp hours since the last lamp change.

The **LAMP RESET button** resets the ETI to zero and turns OFF the REPLACE LAMP indicator LED.

NOTE **The lamp housing power must be plugged in to reset the ETI**

The **REPLACE LAMP light** will come on when the lamp has undergone approximately 90% of the manufacturer's expected lifetime. This does not imply that the lamp's spectral performance meets Class A spectral performance at this level of usage. **LAMP LIFE WILL DIFFER DEPENDING ON THE LEVEL OF USE.** This is especially true if you are operating the lamp at a power different from the nominal power or if your application requires more frequent lamp changes.

NOTE **This indicator is only a visual aid and should be used in conjunction with reading the ETI display.**

The **SHUTTER OPEN light** is lit when the shutter is open.

The **LAMP ON light** is lit when the lamp is energized. Note that this light may stay on for a short time after the lamp is turned off because the lamp electrodes are still glowing enough to activate the photo sensor.

5 Using the System

5.1 Setting Up the Power Supply

Your simulator and power supply were set up and run as a system to certify its performance.

The correct power supply settings for your system including operating power and maximum power limits are stored in the power supply.

Refer to the Power Supply Manuals (M69920 and M69922) for information on modifying the power supply settings.

5.2 Shutter Control

The shutter can be manually controlled using the housing control panel or via a TTL signal through the BNC input connector on that panel.

5.3 Starting the Lamp

1. Verify that all connections are properly in place according to section 4.6 Installing the Lamp. Also verify that all access panels are in place.
2. Turn ON the illuminator power switch and verify that the shutter switch activates the shutter**. Be sure to leave the shutter in the closed position before proceeding.**
3. Turn ON the power supply.
4. Your power supply has been factory set for your SOLARIS and is operating in the constant power mode. The power limit has been set to 10% above the nominal lamp power. Your system has been factory configured to yield one SUN at the working plane after a 30-minute warm-up period. Lamp life may be significantly shortened if the lamp is operated outside the range of +10% to -20%

of the nominal lamp rating.

5. Push the LAMP START switch. The lamp should start. If it does not, wait a few seconds, and then try again. If the lamp does not ignite after several tries, refer to the Power Supply Manuals (69920 and 69922) and section 7. TROUBLESHOOTING of this manual.
6. Verify that all fans are operating. The fans come on at full speed about 10 seconds after the lamp starts. If any fan is not running, shut the system down and contact NEWPORT for assistance.

CAUTION **The fans will continue to run for about 15-20 minutes after the system is shut off in order to cool down the lamp. Do not turn off power from the solar simulator before the fans stop.**

5.4 Power Supply and Digital Exposure System

Refer to the Power Supply Manuals (69920 and 69922) for details on the power supply operation.

The Digital Exposure System Manual describes how to mount the detector/fiber pick-off and how to set up and operate the controller.

6 Routine Maintenance

Routine maintenance is necessary to ensure that your Solar Simulator performs to specification. The following section outlines routine maintenance of the product and its components.

6.1 Lamp Replacement

To remove the old lamp:

1. Wait for the fans to stop running and for the lamp to cool (about 15-20 minutes)
2. Turn OFF and UNPLUG the power supply.
3. Turn OFF and UNPLUG the illuminator.

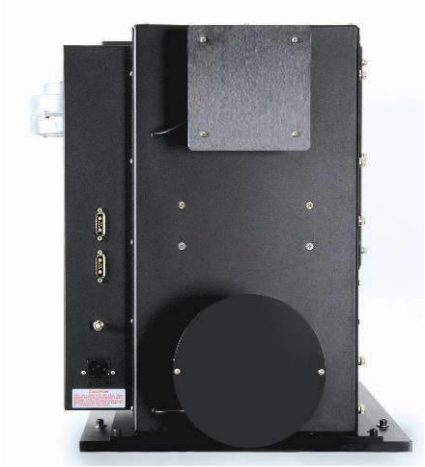


Figure 21: The Illuminator (rear view)

4. Remove the lamp access panel from the housing by unscrewing all panel screws.

Figure 22: Removing the lamp access panel.

Figure 23: Lamp access panel removed.

NOTE **Your lamp and heat sink may appear different than shown depending on your model of SOLARIS™ Solar Simulator.**

5. Loosen the #10-32 thumb nut and remove from the threaded post atop the heat sink.

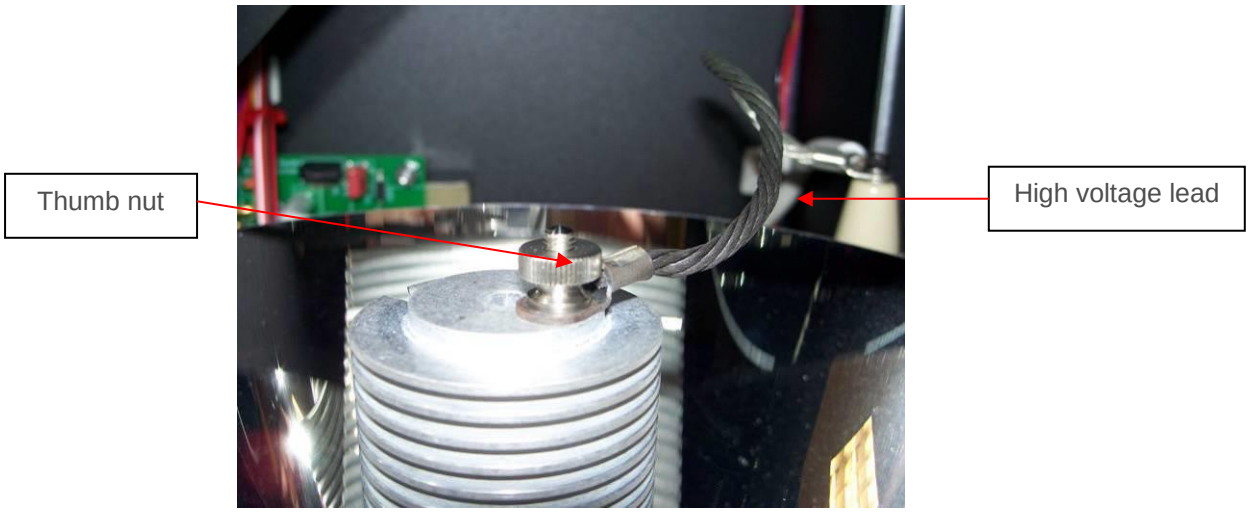


Figure 24: #10-32 thumb nut on heat sink.

6. Remove high voltage lead from the heat sink.

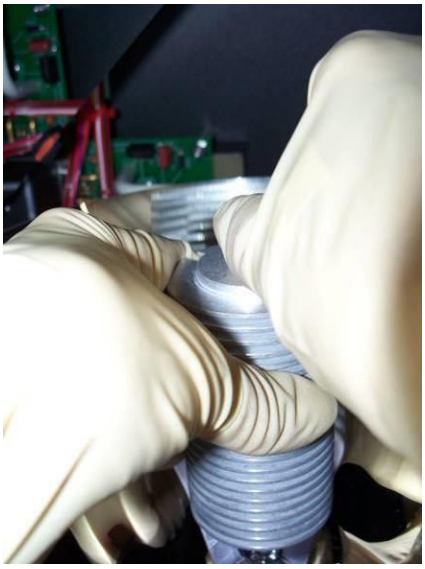


Figure 25: Removing the high voltage lead from the heat sink.

WARNING **Always wear appropriate gloves and impact-resistant goggles when handling the lamp. Refer to Table 9 for a list of Newport-recommended options.**

7. Grasp the heat sink and unscrew the lamp from the socket (counterclockwise).

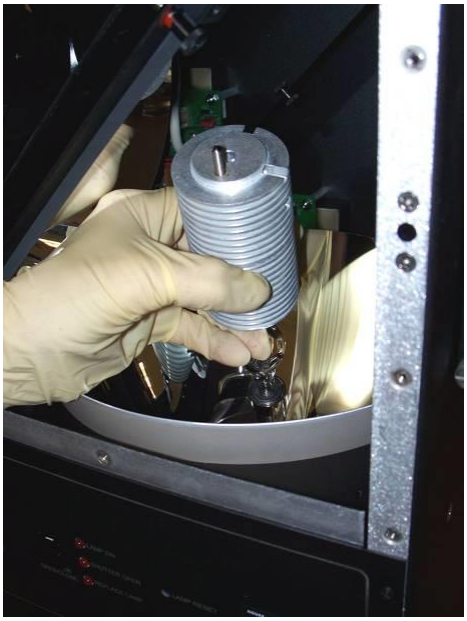


Figure 26: Heat sink unscrewed from socket.

8. Remove the threaded adapter and the heat sink from the lamp endcap. [See sections 4.6.1, 4.6.2, and 4.6.3 for details removal of the adaptor and/or heat sink for the three different lamps.]
9. Inspect the optics to see if they require cleaning or replacement.

NOTE **If cleaning or replacement is required, consult NEWPORT.**

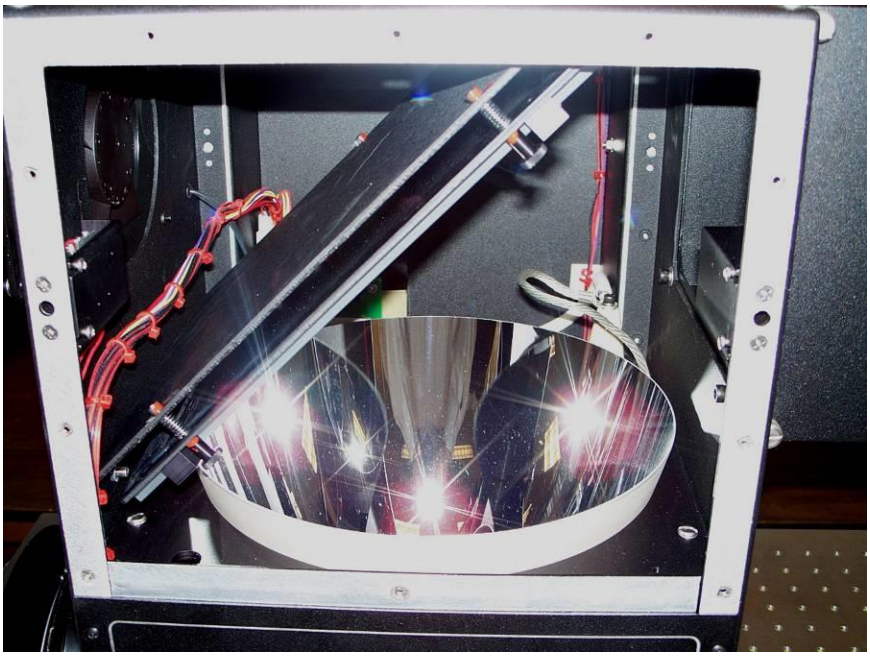


Figure 27: Heat sink and lamp removed.

10. Install the new lamp, following directions detailed in section 4 Installing the Lamp. Refer to sections 4.6.1, 4.6.2, and 4.6.3 for details on installing the three different lamps.
11. Reconnect the AC line cord and turn ON the power switch on the illuminator control panel.
12. Depress the “LAMP RESET” button using a small screwdriver or hex key. The “CHANGE LAMP” indicator should go out and the “LAMP HOURS” should reset to **zero**.

6.2 Lamp Alignment

Once a lamp is replaced it may need to be aligned. Unless the alignment settings are changed for some other reason, this procedure should **only** be performed when a new lamp is installed. We recommend using the 91150V calibrated reference cell and meter to insure 1 SUN at the working plane is achieved.

Although *it is default*, **make sure the shutter is closed** before completing step 1.

1. Refer to the solar simulator test reports, which include the settings used when the system was tested and validated at the factory. Set-up the power supply to the operating power reported in these test reports. Start the lamp and allow it to warm up for at least 10 minutes. Make sure that the knob on the partial SUN attenuator is turned to its maximum in the clockwise direction (partial SUN attenuator in fully open position).

NOTE **For desired results in measuring/testing stability, non-uniformity, or spectral match, the lamp should be allowed to warm-up for at least 30 minutes.**

2. Remove the access panel from the lamp housing panel by loosening the panel screws and identify the adjustment mechanisms (knurled knobs (2) and ladder chain). The ladder chain helps to move the lamp position along the Z (vertical) axis, while the two knurled knobs help to change the position of the lamp in the XY (horizontal) plane but NOT particularly on the X and Y axes.

Figure 28: Lamp focus adjustment mechanisms (Access panel removed)

Place a calibrated reference cell in the optical center of the output at the recommended working distance from the lens vertex. Refer to Table 1: Model Information/Optical Specifications of this manual to determine the appropriate working distance for your particular source.

1. Turn ON and zero your light intensity measuring device with the shutter of the simulator closed.

WARNING **These sources produce intense ultraviolet, visible, and infrared radiation. Always wear adequate eye and skin protection when operating the system. Refer to Table 9 for Newport recommended safety options.**

2. Open the shutter of the SOALRIS simulator and observe the reading.
3. Without changing any of the knob adjustments, adjust the ladder chain (Z-adjust) to obtain a maximum reading on the cell.

NOTE **The ladder chain can become quite warm during operation. While the temperature is not hazardous, you may find it more comfortable as well as easier to make this adjustment by inserting a small hex wrench or screwdriver into the chain and sliding it back and forth.**

Figure 29: Adjustment using the ladder chain.

4. Close the shutter and allow the calibrated reference cell to cool down for approximately five minutes.
5. Open the shutter and turn one of the knurled knobs (X-Y adjust) to read maximum intensity on the calibrated reference cell. Knob adjustments fine tune the lamp position, so DO NOT turn knobs more than 2 rotations in either direction.

Figure 30: Adjustment using the X-Y knobs.

6. Adjust the second knurled knob for maximum intensity; to maintain the lamp position in the desired range, DO NOT turn the knob more than 2 rotations in either direction.
7. Close the shutter, allow the calibrated reference cell to cool, and repeat the three adjustments

to verify the settings. At this point to read the maximum intensity on the calibrated reference cell, one should adjust or make only minor changes to the ladder chain and knurled knobs.

8. Following the procedure stated above typically yields better uniformity, but not necessarily all the time. An operator may use their own procedures and insight to get best possible uniformity by adjusting the ladder chain and X-Y knobs. To be certain about % non-uniformity, the user should manually measure uniformity by using uniformity measurement tools or similar devices.
9. After achieving desired uniformity, close the shutter and replace the access panel.

NOTE

Your unit and lamp were rigorously tested at the NEWPORT facility by manually optimizing lamp position. Following the steps mentioned above will get your system close or within specification to meet percentage non-uniformity standards. In order to ensure your system's performance to meet percentage non-uniformity standards after installing/changing a lamp, you must make measurements on site EACH TIME A LAMP IS REPLACED by adjusting and optimizing the lamp position in order to achieve percentage non-uniformity within specifications of standards.

You may need to adjust the intensity to get 1 SUN (100mW/cm2). You can fine tune the power setting within the specified limits to achieve proper illumination.

6.3 Cleaning Optics

Newport recommends cleaning the optics only by using oil-free air or dry nitrogen to blow off contaminants. For additional cleaning, contact Newport to schedule a cleaning.

CAUTION

The optical components in the system may require removal in order to clean them. Only qualified individuals should perform the removal, installation and any adjustments. Proper handling is essential when working with all highly sensitive optical instruments.

7 Troubleshooting

Troubleshooting Guide		
Problem	**Possible Cause**	**Action**
Lamp does not start	No power	Check that Simulator and Power Supply main power switches are turned on and cables from the power supply to the simulator housing are plugged in.
	Lamp not properly installed	Follow the lamp installation procedure carefully. Connections should be firm.
	Defective or marginal lamp	1. Repeat ignition sequence. 2. Replace lamp.
	Lamp has passed its usable lifetime	Replace lamp.
	Insulation breakdown	**Consult NEWPORT.**
	Interlock fault	1. Check for **iLOC Error** on power supply. Ensure lamp access panels are properly in place and that cables are seated at both ends. Check that the lamp housing is powered ON. 2. If lamp still does not start, **Consult NEWPORT.**
Shutter does not open	Damaged shutter, shutter mechanically jammed	Repair or replace shutter. *Consult Newport.*
	Shutter actuation switch	**Consult NEWPORT** for replacement control board and switch.
	Defective shutter drive circuit	**Consult NEWPORT.**
Loss of power in output beam	Lamp out of focus	Follow instructions in lamp installation for optimization.
	Dirty optic	Clean optics.
	Damaged optic	Inspect all optics for damage and replace.
	Old lamp	Replace lamp.

Troubleshooting Guide		
Problem	**Possible Cause**	**Action**
Loss of beam uniformity	Lamp alignment	Align lamp.
Output unstable	Old lamp	Replace lamp.
	Lamp over/under driven	Run lamp at **proper wattage** only (nominal –20%, +10%)
	Improper use of Exposure Controller	Refer to Digital Exposure System Manual.
Lamp explodes	Fingerprints on lamp	Replace lamp. BE SURE TO WEAR PROTECTIVE GLOVES WHEN INSTALLING NEW LAMPS.
	Old lamp	Replace lamp based on **specified lamp lifetime**.
	Incorrect lamp polarity	Make sure the lamp is installed correctly
	Lamp over driven	Run lamp at **proper wattage** only (nominal –20%, +10%).

Table 8: Troubleshooting Guide

Figure 31: Lamp run under reverse polarity.

8 Returns

8.1 Contacting Oriel Instruments

Oriel Instruments belongs to Newport Corporation's family of brands. Thanks to a steadfast commitment to quality, innovation, hard work and customer care, Newport is trusted the world over as the complete source for all photonics and laser technology and equipment.

Founded in 1969, Newport is a pioneering single-source solutions provider of laser and photonics components to the leaders in scientific research, life and health sciences, photovoltaics, microelectronics, industrial manufacturing and homeland security markets.

Newport Corporation proudly serves customers across Canada, Europe, Asia and the United States through 9 international subsidiaries and 24 sales offices worldwide. Every year, the Newport Resource catalog is hailed as the premier sourcebook for those in need of advanced technology products and services. It is available by mail request or through Newport's website. The website is where one will find product updates, interactive demonstrations, specification charts and more.

To obtain information regarding sales, technical support, or factory service, United States and Canadian customers should contact Oriel Instruments directly.

Newport - Oriel Instruments

1791 Deere Avenue

Irvine, CA 92606 USA

Telephone: 877-835-9620 (toll-free in United States)
800-222-6440
Fax: 949-253-1680

Sales: salesirv@mksinst.com
Technical assistance & Repair Service: salesirv@mksinst.com

Customers outside of the United States must contact their regional representative for all sales, technical support and service inquiries. A list of worldwide representatives can be found on Newport's website. https://www.newport.com/contact/contactslocations

8.2 Request for Assistance / Service

Please have the following information available when requesting assistance or service:

- Contact information for the owner of the product.
- Instrument model number (located on the product label).
- Product serial number and date of manufacture (located on the product label).
- Description of the problem.

To help Oriel's Technical Support Representatives diagnose the problem, please note the following:

- Is the system used for manufacturing or research and development?
- What was the state of the system right before the problem?
- Had this problem occurred before? If so, when and how frequently?
- Can the system continue to operate with this problem, or is it non-operational?
- Were there any differences in the application or environment before the problem occurred?

8.3 Repair Service

This section contains information regarding factory service for this product. The user should not attempt any maintenance or service of the system beyond the procedures outlined in this manual. This product contains no user serviceable parts other than what is noted in this manual. Any problem that cannot be resolved should be referred to Oriel Instruments.

If the instrument needs to be returned for service, a Return Material Authorization (RMA) number must be obtained prior to shipment to Oriel Instruments. This RMA number must appear on both the shipping container and the package documents.

Return the product to Oriel Instruments, freight prepaid, clearly marked with the RMA number and it will either be repaired or replaced it at Oriel's discretion.

Oriel is not responsible for damage occurring in transit. The owner of the product bears all risk of loss or damage to the returned products until delivery at Oriel's facility. Oriel is not responsible for product damage once it has left the facility after repair or replacement has been completed.

Oriel is not obligated to accept products returned without an RMA number. Any return shipment received by Oriel without an RMA number may be reshipped by Newport, freight collect, to the owner of the product.

8.4 Non-Warranty Repair

For products returned for repair that are not covered under warranty, Newport's standard repair charges shall be applicable in addition to all shipping expenses. Unless otherwise stated in Newport's

repair quote, any such out-of-warranty repairs are warranted for ninety (90) days from date of shipment of the repaired Product.

Oriel will charge an evaluation fee to examine the product and determine the most appropriate course of action. Payment information must be obtained prior to having an RMA number assigned. Customers may use a valid credit card, and those who have an existing account with Newport Corporation may use a purchase order.

When the evaluation had been completed, the owner of the product will be contacted and notified of the final cost to repair or replace the item. If the decision is made to not proceed with the repair, only the evaluation fee will be billed. If authorization to perform the repair or provide a replacement is obtained, the evaluation fee will be applied to the final cost. A revised purchase order must be submitted for the final cost. If paying by credit card, written authorization must be provided that will allow the full repair cost to be charged to the card.

8.5 Loaner / Demo Material

Persons receiving goods for demonstrations or temporary use or in any manner in which title is not transferred from Newport shall assume full responsibility for any and all damage while in their care, custody and control. If damage occurs, unrelated to the proper and warranted use and performance of the goods, recipient of the goods accepts full responsibility for restoring the goods to their original condition upon delivery, and for assuming all costs and charges.

9 Products and Accessories

Products and Accessories		
Description	**Part Number**	**Models Used-on**
Xenon Lamp 450 W	6280NS	SOLARIS 2, SOLARIS 4
450W Heat Sink Assembly	90023031	SOLARIS 2, SOLARIS 4
Xenon Lamp 1.0 kW	6272	SOLARIS 6
1.0kW Heat Sink Assembly	90023032	SOLARIS 6
Xenon Lamp 1.6 kW	62726	SOLARIS 8, SOLARIS 12
1.6kW Heat Sink Assembly	90026576	SOLARIS 8, SOLARIS 12
High Voltage Cable Assembly	90020485	SOLARIS 2, SOLARIS 4, SOLARIS 6, SOLARIS 8, SOLARIS 12
Shutter Assembly	91199	SOLARIS 2, SOLARIS 4, SOLARIS 6, SOLARIS 8
Shutter Assembly	90034480	SOLARIS 12
Solar Simulator Digital Exposure System	68951	SOLARIS 2, SOLARIS 4, SOLARIS 6, SOLARIS 8, SOLARIS 12
Remote Shutter Control	68955	SOLARIS 2, SOLARIS 4, SOLARIS 6, SOLARIS 8, SOLARIS 12
Ignitor Assembly	92514-1050	SOLARIS 2, SOLARIS 4, SOLARIS 6, SOLARIS 8, SOLARIS 12

Products and Accessories		
Description	**Part Number**	**Models Used-on**
UV Protective Eyewear/Goggles	49125, 49126, 49132	SOLARIS 2, SOLARIS 4, SOLARIS 6, SOLARIS 8, SOLARIS 12
Protective Gloves	49121, 49123	SOLARIS 2, SOLARIS 4, SOLARIS 6, SOLARIS 8, SOLARIS 12

Table 9: Products and Accessories

To obtain these products and accessories, please contact NEWPORT.

For more information visit: https://www.newport.com/b/oriel-instruments.

Appendix A: Dimensional and Mounting Diagrams

NOTE **For the figures in this appendix, dimensions are listed in inches and [millimeters].**

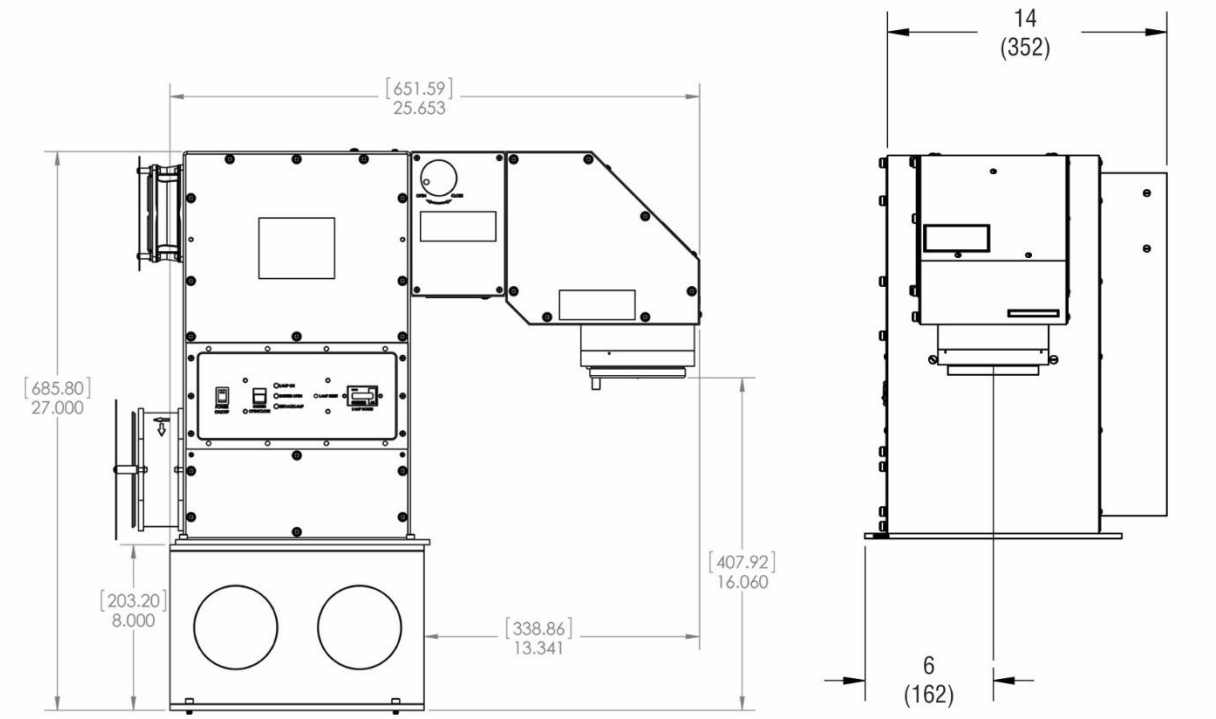


Figure 32: 2x2 System (Solaris 2)

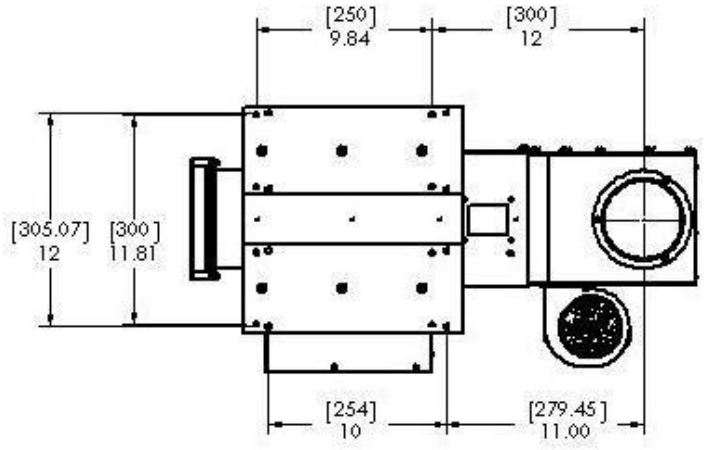


Figure 33: Base Plate Mounting Hole Locations Relative to Optical Centerline for 2x2 system.

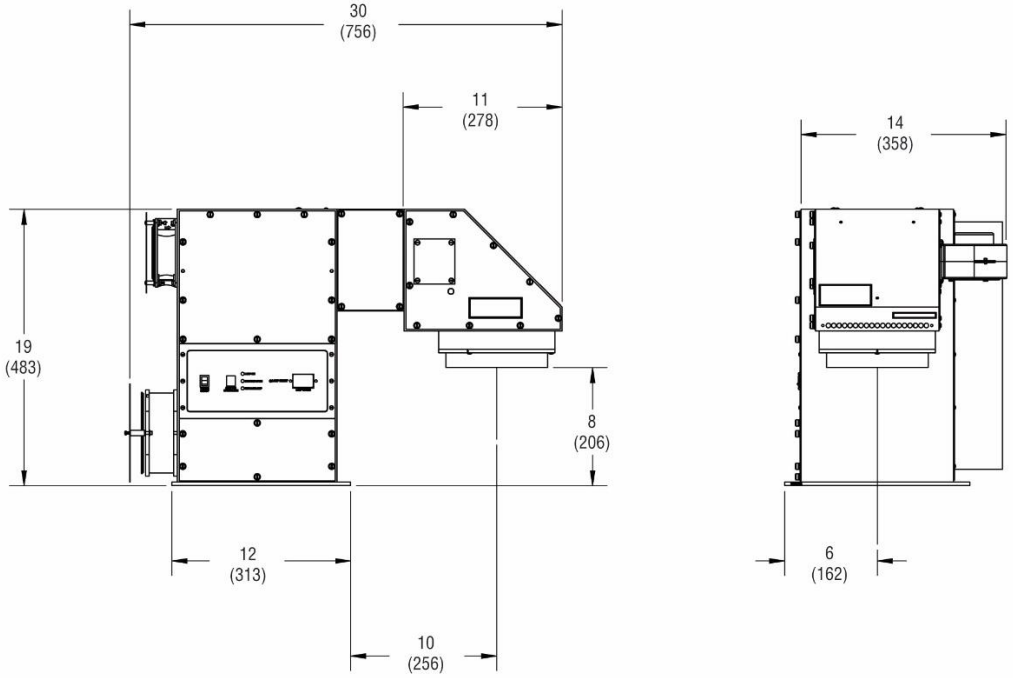


Figure 34: 4x4 System (Solaris 4)

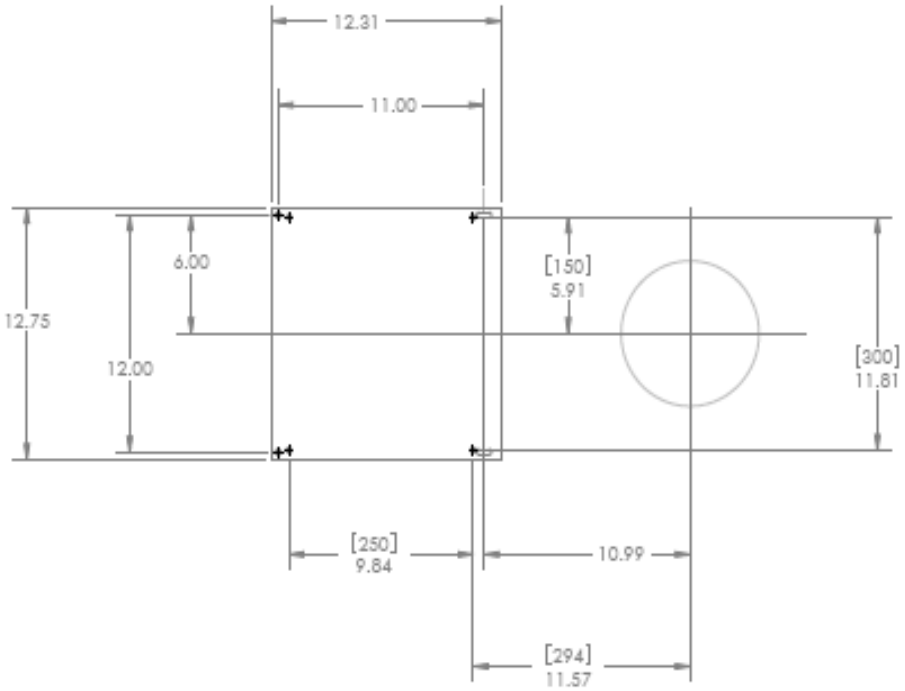


Figure 35: Base Plate Mounting Hole Locations Relative to Optical Centerline for 4x4 system.

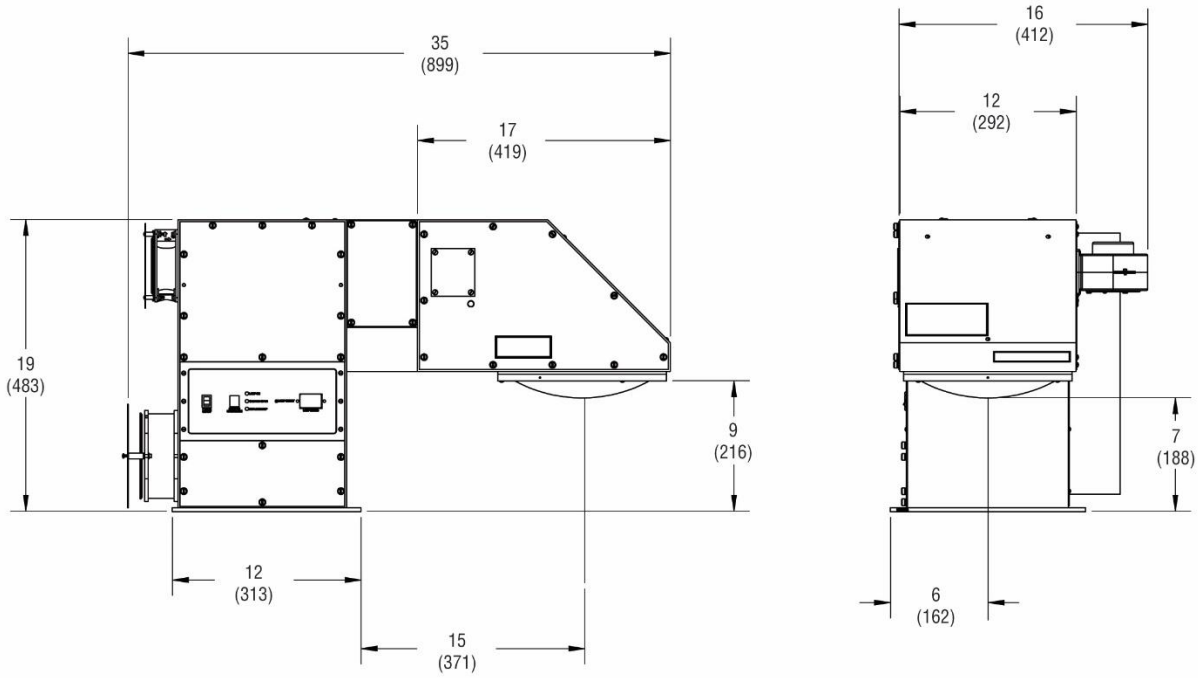


Figure 36: 6x6 System (Solaris 6)

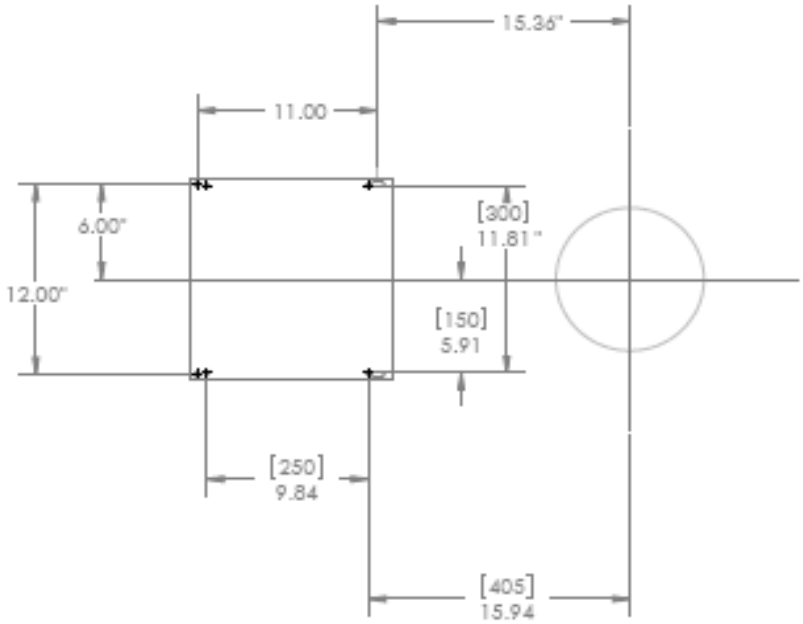


Figure 37: Base Plate Mounting Hole Locations Relative to Optical Centerline for 6x6 system.

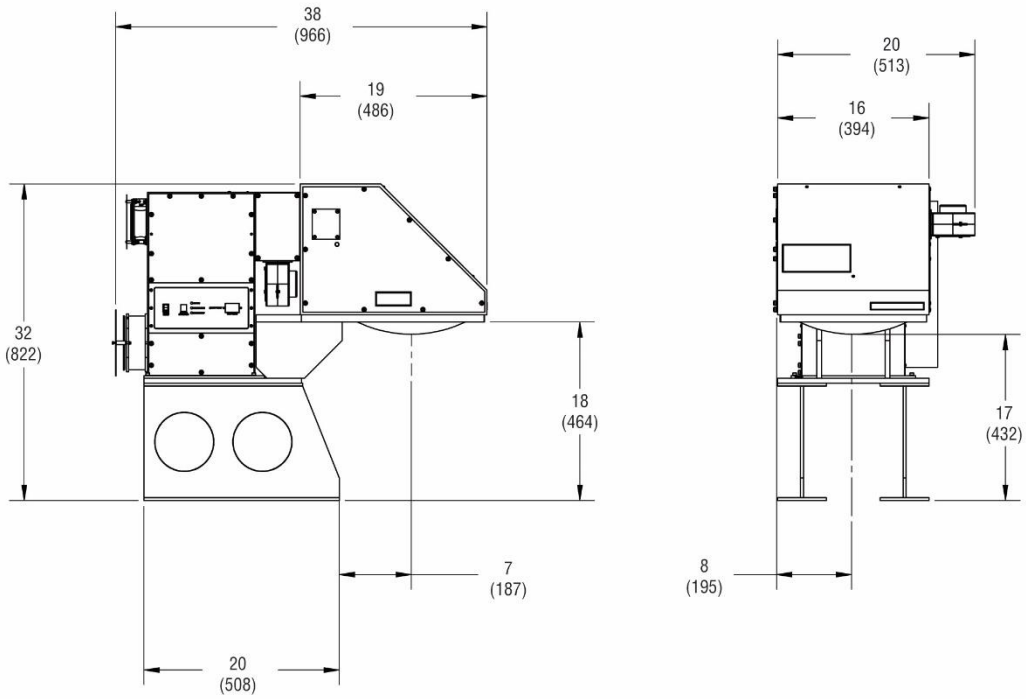


Figure 38: 8x8 System (Solaris 8)

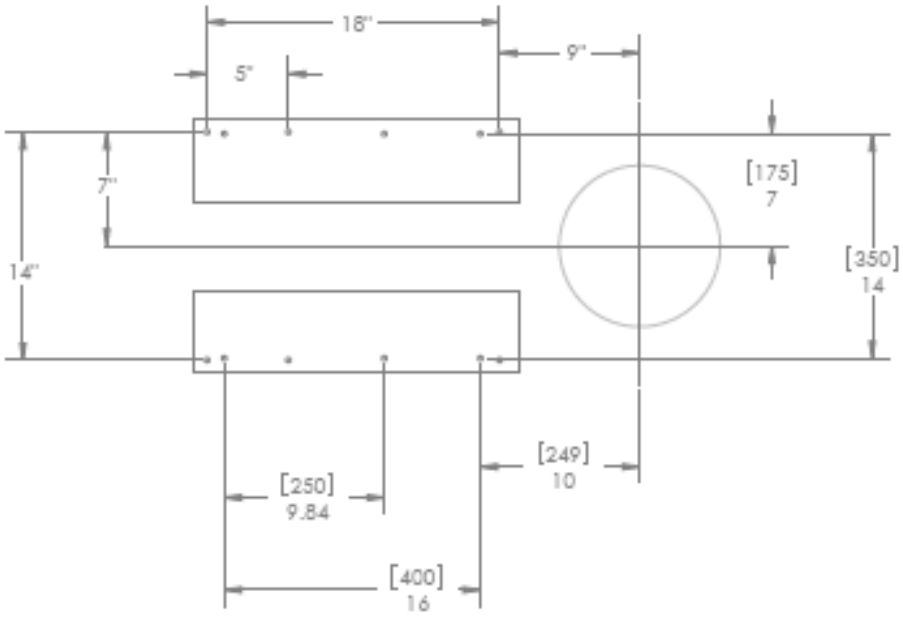


Figure 39: Base Plate Mounting Hole Locations Relative to Optical Centerline for 8x8 system.

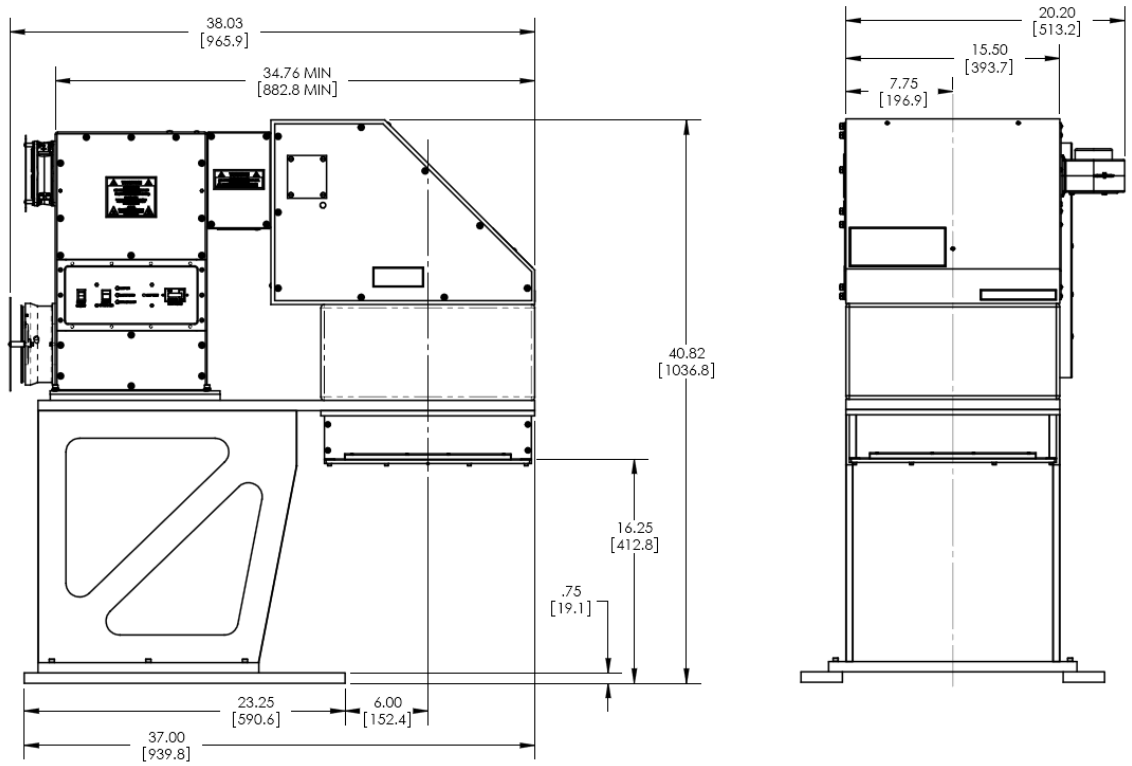


Figure 40:12x12 System (Solaris 12)

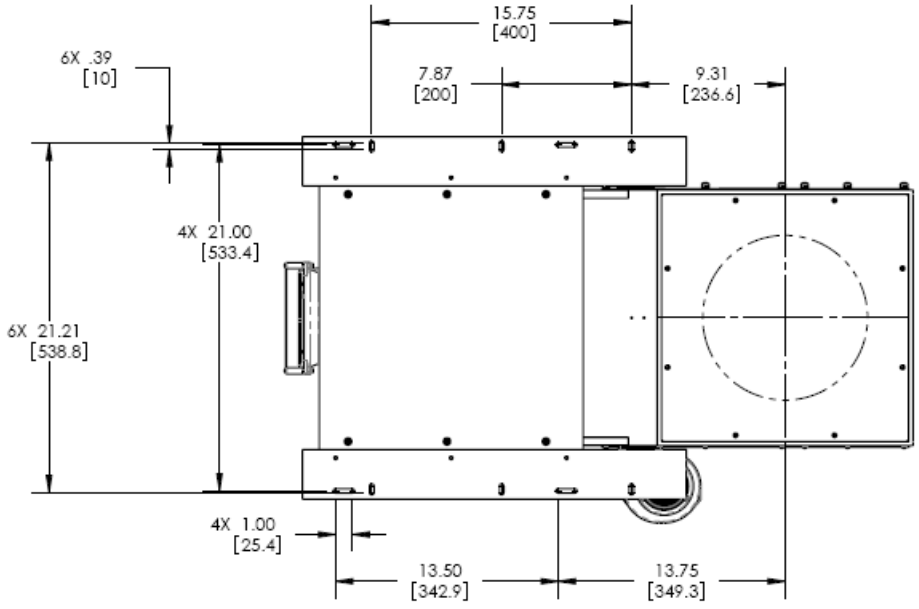


Figure 41: Base Plate Mounting Hole Locations Relative to Optical Centerline for 12x12 system

Appendix B: Reports and Certifications

NON-UNIFORMITY REPORT

Performance validation procedure of Non-uniformity of irradiance:

1. IEC non-uniformity of irradiance of Sol3A Model 90021636, Serial# 101 is 1.62%

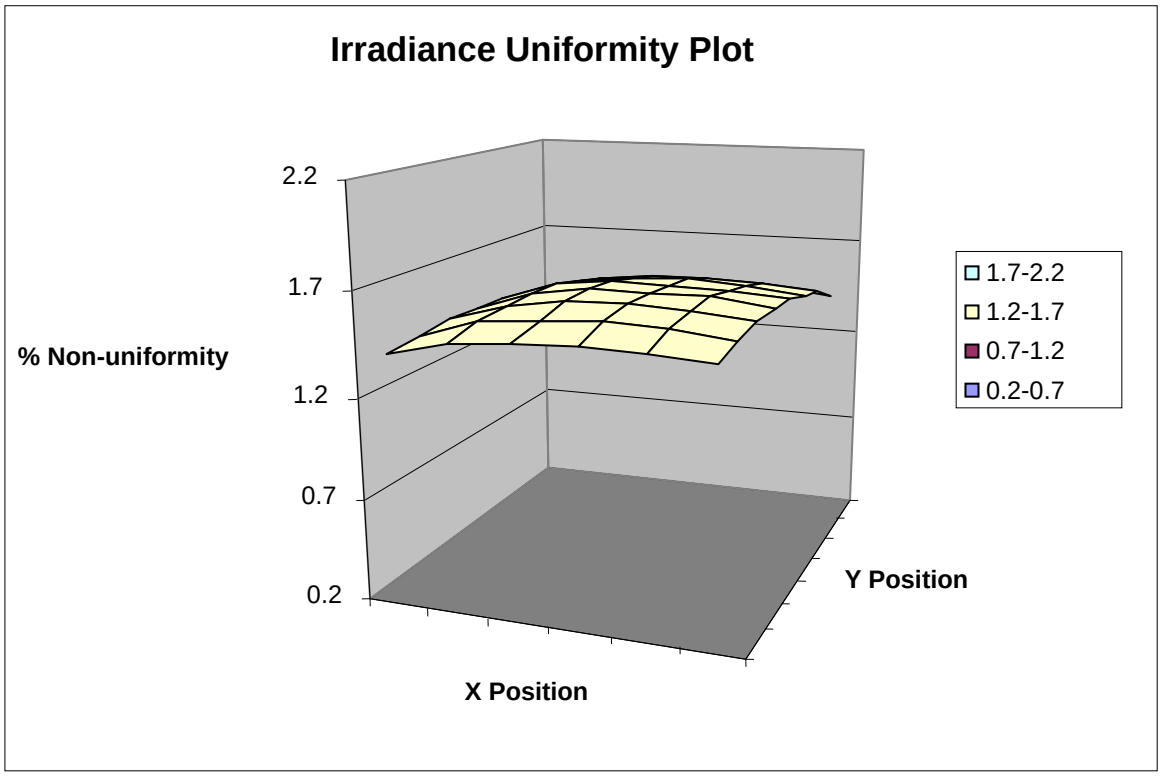
64 equally sized (by area) test positions (blocks). The uniformity detector size is designated test area divided by 64. A single detector is used for measurements covering 100% of the designated area and the measurement positions are distributed uniformly over the designated test area.

2. ASTM non-uniformity of irradiance of Sol3A Model 90021636, Serial# 101 is 1.62%

The ASTM uniformity measurement data consists of 36 data points, where the defined test area is divided into 36 equally sized (by area) test positions (blocks). The uniformity detector is equal to the area of the individual test positions (blocks). A single detector is used for measurements covering 100% of the defined area and the measurement positions are distributed uniformly over the defined test area.

3. JIS non-uniformity of irradiance of Sol3A Model 90021636, Serial# 101 is 1.28%.

The JIS uniformity measurement data consists of 17 data points as required and mapped in JIS standard for measuring positional non-uniformity of irradiance, where a single square detector is used with side not exceeding 2 cm.

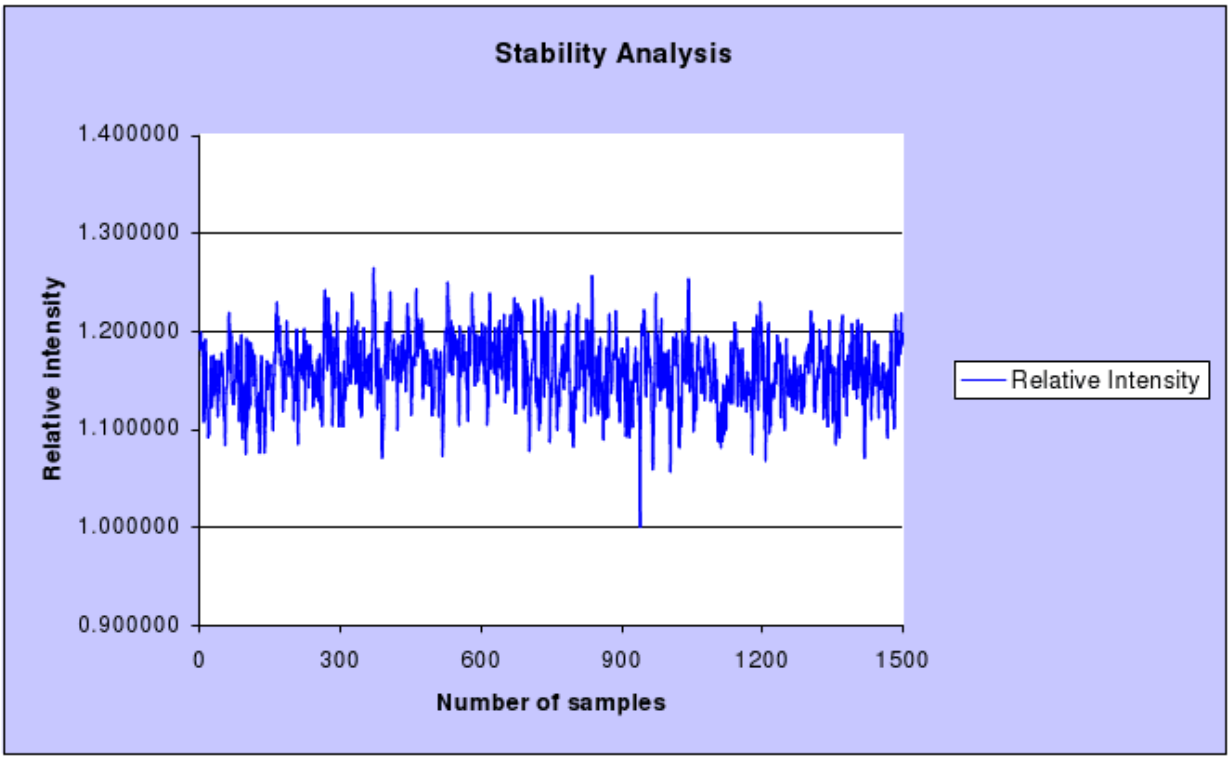


TEMPORAL INSTABILITY REPORT

Performance validation procedure of temporal instability of irradiance:

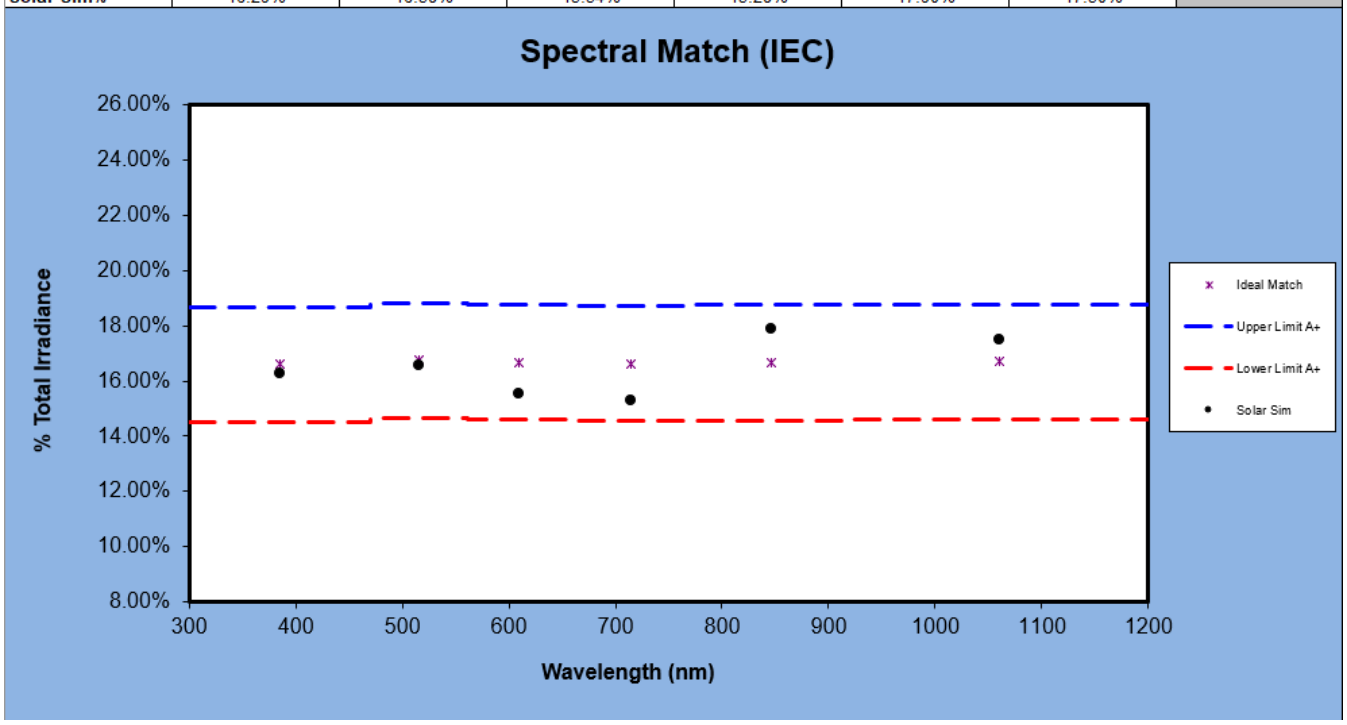
1. Temporal instability of irradiance of Sol3A Model 90021636, Serial# 101 is 0.37%

The temporal instability measurement data consists of 15000 samples. Each sample is equally distributed and continously acquired over 60.24 seconds.



SPECTRAL MATCH REPORT

	IEC						
	300-470	470-561	561-657	657-772	772-919	919-1200	300-1200
Ideal Match%	16.61%	16.74%	16.67%	16.63%	16.66%	16.69%	100.00%
Upper Limit%	18.69%	18.83%	18.75%	18.71%	18.74%	18.78%	
Lower Limit%	14.53%	14.65%	14.59%	14.55%	14.58%	14.60%	
Solar Sim%	16.29%	16.58%	15.54%	15.28%	17.90%	17.50%	



SPECTRAL COVERAGE AND DIVERGENCE

Spectral Coverage And Spectral Divergance
Spectral coverage and spectral divergence were calculated using irradiance data gathered during spectral match measurement. Spectral coverage is a percentage of the solar simulator spectral irradiance larger than 10% of the AM1.5 reference spectrum. Spectral divergence is the percentage of summed deviations between the solar simulator spectral irradiance and the AM1.5G reference spectrum.

Spectral Coverage: 100.0%
Spectral Divergence: 41.4%