SORICSCREEN™

The Ideal Ultraviolet to Near Infrared White Screen Solution:
Cost-Effective, High Reflectance, Large-Area, Rollable, Cleanable, and Portable.

For Use At:

• Observatories • Laboratories • Outdoor Field Sites •

To Serve The Functions Of:

• Calibration • Projection • Diffusion • Visual Target Cues •
• Stray Light Control • Thermal Control •

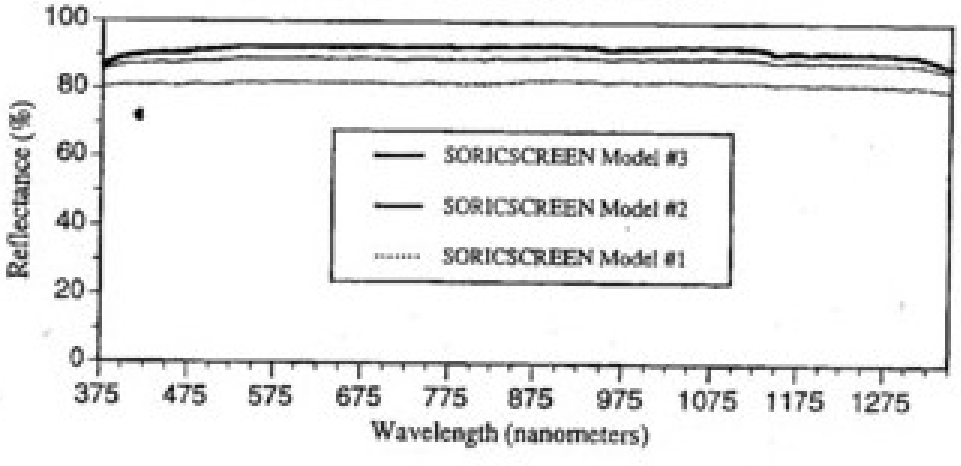
In Application Areas Such As:

• Astronomy • Remote Sensing • Machine Vision • Laser Rangefinding •
• Biomedical Research • Laser Physics •

Attributes:

- High, Diffuse, Spectrally Flat Reflectance from UV to NIR
- Large Areas & Lightweight
- Cleanable & Durable
- Easily Rolled & Transported
- Optically, Chemically & Thermally Stable
- Easy To Install & No Maintenance
- Cost Effective & Practical

Reflectance of SORICSCREEN™



• Tel: (905) 731-6088 • Fax: (905) 731-6674 • Internet: soric@csr.ists.ca •

SORICSCREEN™

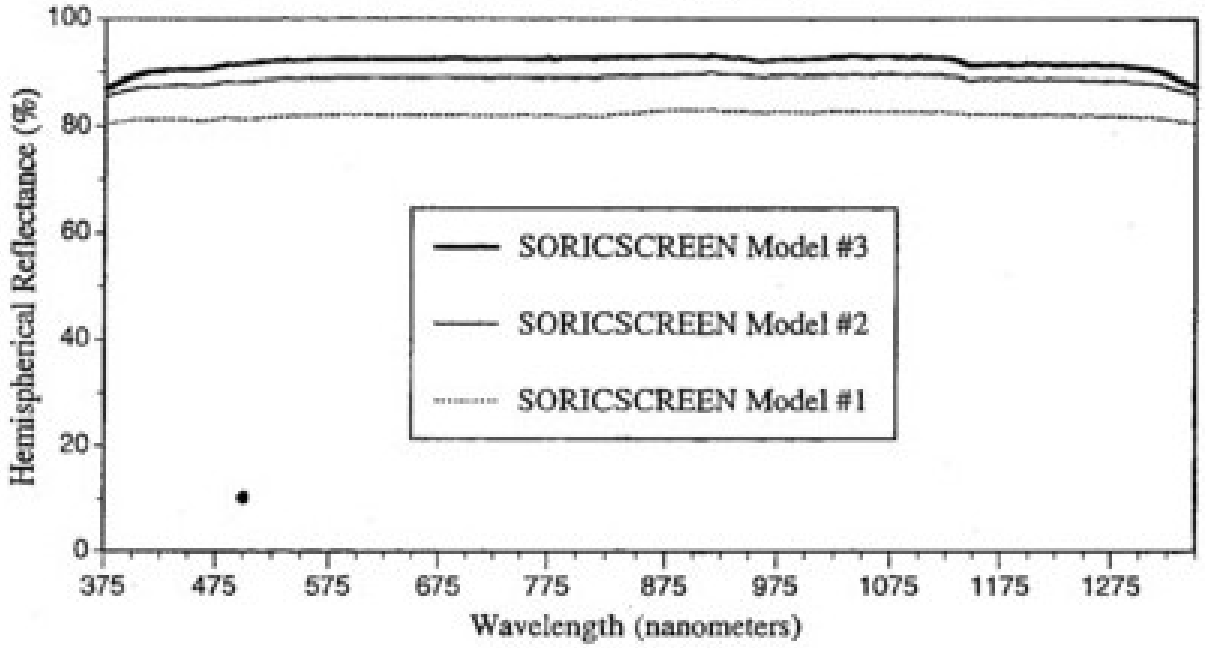
The Most Cost-Effective, High Ultraviolet to Near Infrared Reflectance, Practical & Versatile, Large-Area, Rollable, Cleanable, and Portable, White Screen Solution Available

Stellar Optics Research International Corporation's (SORIC) SORICSCREEN™ is a white screen, whose high, uniform, diffuse reflectance makes it an excellent screen from the Ultraviolet (UV) to the Near-Infrared (NIR) spectral region, to serve a variety of functions such as: **calibration, projection, diffusion, visual target cues, stray light control, and thermal control**. SORICSCREEN™ is used to calibrate data acquired with detectors employed in instruments such as imaging telescopes, spectrographs, interferometers, and microscopes in fields such as: **astronomy, remote sensing, machine vision, laser rangefinding, biomedical research, laser physics**. SORICSCREEN™ is used in **observatories, laboratories, and at outdoor field sites**. SORICSCREEN™ is ideal for field applications or when a large, diffuse reflector is needed that can be easily transported, since SORICSCREEN™ is **lightweight, cleanable, easily rolled, and will withstand survival conditions at high altitude astronomical observatories.**

SORICSCREEN™ is made of a **unique, pre-shrunk, textile, which makes it a flexible, easy-to-install, no-maintenance, one-screen solution from the UV to the NIR.** It will enable you to take full advantage of the performance of your detection system, particularly if it is sensitive in the ultraviolet region of the spectrum. SORIC has developed specialized manufacturing techniques to strengthen and optimize the textile material for use as a large-area screen, and SORIC provides sturdy screen mounting loops for easy installation. SORIC offers three models of SORICSCREEN™ which differ in reflectivity, as described below.

Ultraviolet to Visible Reflectance of SORICSCREEN™

Reflectance* of SORICSCREEN™ Models 1, 2, and 3 showing high, spectrally-uniform reflectance from 375 to 1350 nm.



* Reflectance measurements shown represent the minimum reflectance since a black backing plate was used. Actual reflectance during use may be higher for non-black backgrounds. Reflectance measurements are 8° hemispherical reflectance (traceable to NRCC - the National Research Council of Canada) measured on a 150 mm diameter Labsphere RSA-PE-19 integrating sphere accessory on a Perkin Elmer Lambda 19 Spectrophotometer.

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SORICSCREEN™ Features

OPTICAL FEATURES and CLEANABILITY:

• From the **Ultraviolet to the Near Infrared spectral region** SORICSCREEN™ exhibits **high, diffuse reflectance** which is **spectrally flat**. SORICSCREEN™ **does not exhibit fluorescence.**

• From the **UV to the NIR**, SORICSCREEN™ **uniformly scatters light in all directions** even out to viewing angles approaching 90 degrees.

• SORICSCREEN™ **is cleanable.** SORICSCREEN™s have been used at remote outdoors sites and exposed to conditions such as volcanic dust, sea water, pollen and polution. SORIC's specially-developed, easy-to-use cleaning procedure will remove even the toughest stains yet **leave the optical properties unaffeted, even in the ultraviolet spectral region.**

MECHANICAL, THERMAL & CHEMICAL FEATURES:

• **Flexible** enough to be **rollable** (i.e. like a window shade) and conveniently **portable**, particularly with SORIC's **water-resistant, durable, compact transporting tube.**

• **Durable and strong** enough to **withstand the survival conditions** of outdoor field sites and astronomical observatories at high altitude.

• **Homogeneous** throughout the thickness of the screen **textile; not a** powder, or paint or coated substrate so there **are no preparation or adhesion problems**; contains **no adhesives** in any part of the product (i.e. entirely stitched)

• **Thermal and Chemical stability:** SORICSCREEN™ maintains its strength and resiliency up to **1800°F**, and is an **asbestos-free** textile; SORICSCREEN™ **resists oxidation & most corrosive solutions & chemicals.** SORICSCREEN™ material and holders are **completely sewn, and contain no adhesives.**

APPEARANCE:

• **Standard screen models** come equipped with a durable mounting arrangement making SORICSCREEN™ **easy to install** (Note: the mounting bars are not included, since requirements differ from site to site).

• **No maintenance is required.** Since it is rollable it can be **easily stored in a compact form** or **moved to different locations quickly.** It is shipped in compact rolls which are **easy to unroll on-site**

• Overall shape of SORICSCREEN™s are shown below.

SIZES, SHAPES & ACCESSORIES:

• Sizes and Shapes: Standard SORICSCREEN™s are square in shape and standard sizes range from 8x8 inches to 10x10 meters but SORICSCREEN™ can be made to virtually any size; **Customized shapes and sizes available**, even for very large screens (please see the attached list of sizes & prices).

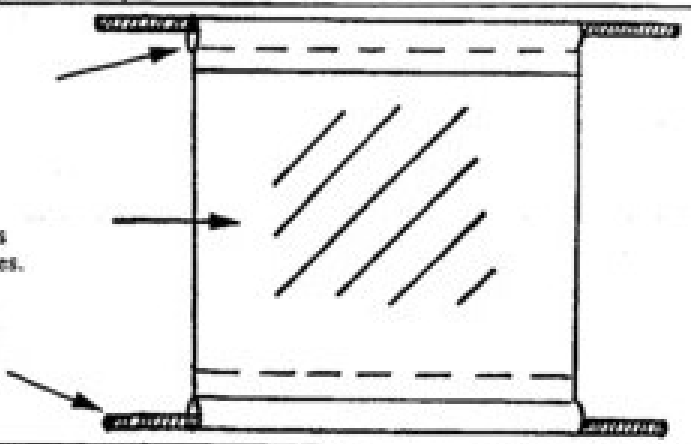
• Spectral Reflectance Data: SORIC can provide representative spectral reflectance data in digital format on diskette at 5 nm intervals from 250 to 2500 nm, and 10 cm^{-1} intervals from 2.5 to 15 µm (please see the attached price list).

• Transportation Tubes: SORIC can provide water-resistant, durable, compact, plastic carrying/transportation tubes (please see the attached price list).

Mounting loops made of a specially-reinforced material securely sewed to the screen's viewing area. The bottom mounting loop is manually adjustable so the tension in SORICSCREEN™ can be periodically readjusted, if necessary.

Viewing area of SORICSCREEN™. Since the screens come in rolled segments that are 33 inches wide, multipanel screens overlap at every 33 inches.

A solid mounting rod is inserted in the mounting loops and secured to the wall, ground, or ceiling. (SORIC does not supply the mounting rod).



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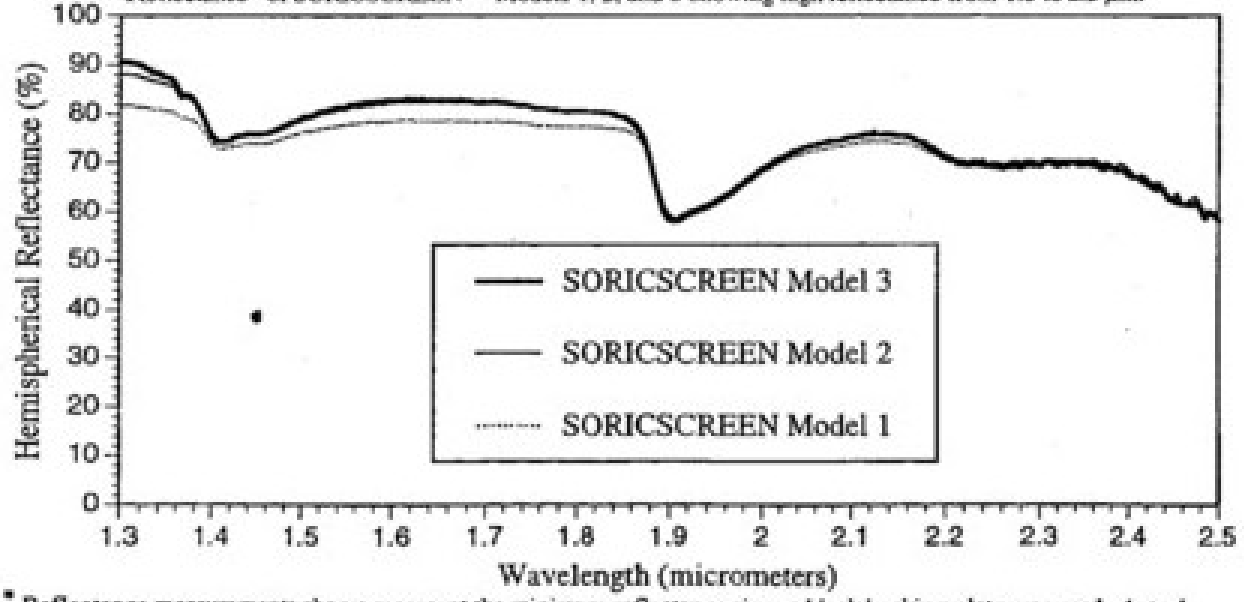
Advantages of Using SORICSCREEN™

Disadvantages of surfaces and materials traditionally used for calibration purposes (e.g. aluminum, common white or reflective paints, paper, styrofoam, etc.)	Advantages of using SORICSCREEN™, and how it overcomes the disadvantages of commonly used materials.
(1) They may exhibit poor reflectance in the ultraviolet and may be specularly reflective (i.e. shiny) as opposed to diffusely reflective.	(1) SORICSCREEN™ has high, uniform reflectance from the ultraviolet to the near infrared spectral region. It is a white, diffuse, specularly-uniform reflector which reflects light uniformly in all directions, even for viewing angles approaching 90°.
(2) They can fluoresce as a result of chemical brighteners used to increase whiteness, which also cause them to be optically unstable. Also, they may not be cleanable.	(2) SORICSCREEN™does not fluoresce and it is optically stable. SORICSCREEN™ is cleanable; SORIC's easy-to-use cleaning procedure will not affect the optical performance, even in the ultraviolet spectral region.
(3) They may not be robust, making large sheets mechanically unstable in high-wind conditions.	(3) SORICSCREEN™ is durable and robust enough to be mounted anywhere in an observatory dome or in the field and can withstand high wind conditions.
(4) There may be size limitations, and even if large screens can be created they can be difficult to move or store.	(4) SORICSCREEN™ can be manufactured to virtually any size. It is so flexible it is rollable, and convenient to move and/or store.
(5) Screens made from painted or coated surfaces can exhibit adhesion problems, and the application procedures can be cumbersome and time consuming, particularly for white coatings with high reflectivity in the ultraviolet.	(5) Since SORICSCREEN™ is a textile it is homogeneous throughout its thickness and there are no preparation or adhesion problems like those with powders, paints or coated surfaces.
(6) Most substances with superior optical performance are either too expensive for many users, and/or require cumbersome preparation and/or application procedures.	(6) SORICSCREEN™ is inexpensive, given the superior optical performance. It is easy to install and no maintenance is required.

Near Infrared Reflectance of SORICSCREEN™

Reflectance* of SORICSCREEN™ Models 1, 2, and 3 showing high reflectance from 1.3 to 2.5 µm.



* Reflectance measurements shown represent the minimum reflectance since a black backing plate was used. Actual reflectance during use may be higher for non-black backgrounds. Reflectance measurements are 8° hemispherical reflectance (traceable to NRCC - the National Research Council of Canada) measured on a 150 mm diameter Labsphere RSA-PE-19 integrating sphere accessory on a Perkin Elmer Lambda 19 Spectrophotometer.

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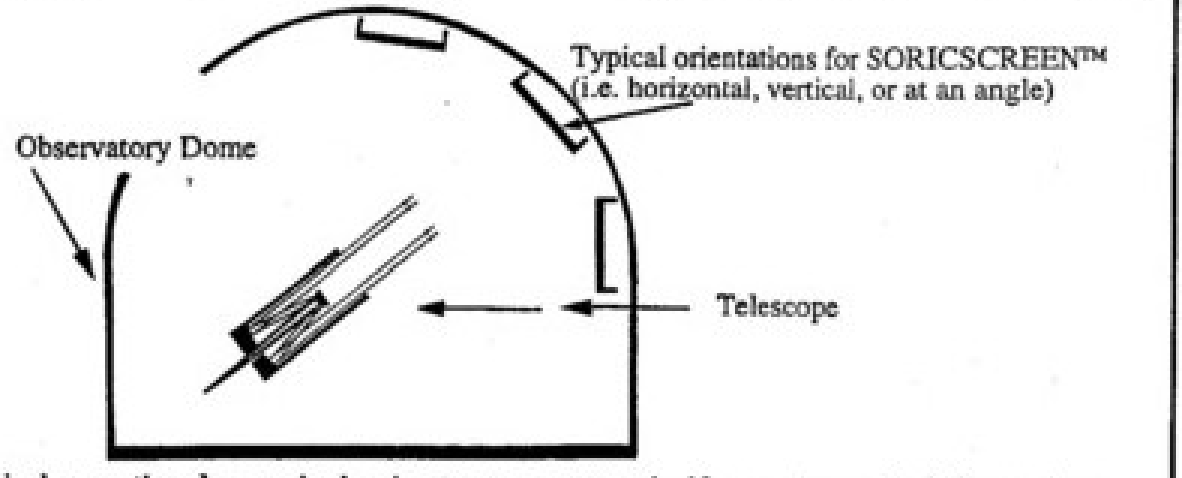
Astronomical Applications of SORICSCREEN™

SORICSCREEN™ offers higher, more spectrally uniform, and more diffuse reflectance from the UV to the NIR than substances traditionally employed in astronomical observatories such as cardboard, Styrofoam, common paints, or the dome wall. Unlike those substances, SORICSCREEN™ is flexible, rollable, and cleanable, and it resists environmental degradation. It is also easier to install, move and maintain, and it withstands the survival conditions of observatory dome environments even at high-altitude. Other practical advantages are described on the previous page. SORICSCREEN™s as large as 13.75 x 13.75 feet (i.e. 4.19 x 4.19 meters) are being used at many major observatories throughout the world.

Reflectance of SORICSCREEN™ at Selected, Standard Astronomical Filter Passbands

Standard Designation of Filter Passbands of Astronomical Interest	Effective Wavelength of the Filter Passband	Reflectance of SORICSCREEN Model 1*	Reflectance of SORICSCREEN Model 2*	Reflectance of SORICSCREEN Model 3*
U	0.3659 µm	80%	85%	86%
[OII]	0.3727 µm	80%	85%	87%
B	0.4363 µm	81%	88%	90%
[OIII]	0.5007 µm	81%	88%	92%
V	0.5448 µm	82%	89%	92%
R_C	0.6407 µm	82%	89%	92%
Hα	0.6563 µm	82%	89%	93%
I_C	0.7982 µm	82%	89%	93%
J	1.25 µm	82%	89%	91%
H	1.65 µm	79%	82%	83%
K	2.2 µm	71%	71%	71%

* Reflectance measurements shown represent the minimum reflectance since a black backing plate was used. Actual reflectance during use may be higher for non-black backgrounds. Reflectance measurements are 8° hemispherical reflectance (traceable to NRCC - the National Research Council of Canada) measured on a 150 mm diameter Labsphere RSA-PE-19 integrating sphere accessory on a Perkin Elmer Lambda 19 Spectrophotometer.



Typical operational scenario showing SORICSCREEN™ inside an astronomical observatory.

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Laser, Remote Sensing and Other Applications of SORICSCREEN™

SORICSCREEN™s are used throughout the world to perform a variety of functions in a variety of application areas as shown below. In addition to laboratory use, SORICSCREEN™s have been used in remote sites such as mountaintops, and at sea. The reflectance of Models 1, 2, and 3, at some common laser lines is shown in the table below.

SORICSCREEN™s serve the functions of:

- Calibration
- Projection
- Diffusion
- Visual Target Cues
- Stray Light Control
- Thermal Control

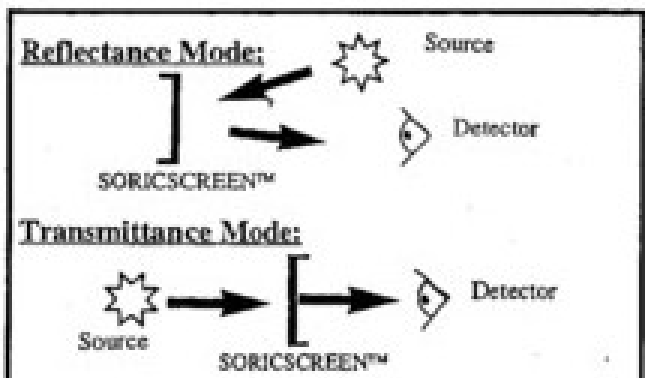
SORICSCREEN™s are used in fields such as:

- Remote Sensing
- Machine Vision
- Laser Rangefinding
- Biomedical Research
- Laser Research
- Astronomy

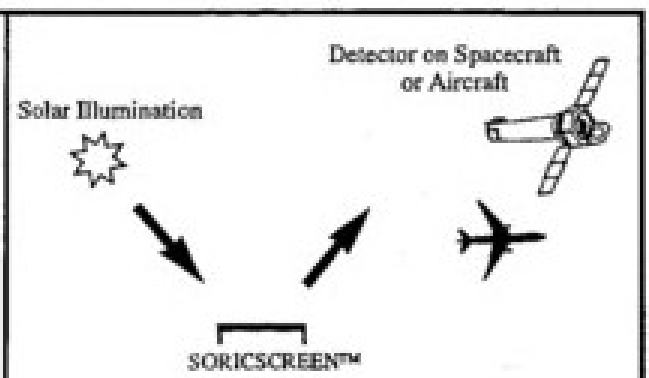
Reflectance of SORICSCREEN™ at Selected Laser Wavelengths

Laser Source Name	Effective Wavelength	Reflectance of SORICSCREEN Model 1*	Reflectance of SORICSCREEN Model 2*	Reflectance of SORICSCREEN Model 3*
Excimer XeCl	0.308 µm	71%	72%	73%
Pulsed N_2	0.3371 µm	79%	83%	84%
Excimer XeF	0.351 µm	80%	84%	85%
Ar^+	0.488 µm	82%	88%	91%
Ar^+	0.5145 µm	82%	89%	92%
Pulsed Ne	0.5401 µm	82%	89%	92%
Kr^+	0.5682 µm	82%	89%	92%
Ne	0.6328 µm	82%	89%	93%
Kr	0.647 µm	82%	89%	93%
Pulsed ruby	0.6943 µm	82%	89%	93%
GaAs	0.8446 µm	83%	89%	93%
GaAs	0.9 µm	83%	90%	93%
Nd*	1.06 µm	83%	90%	93%
GaSb	1.5 µm	76%	79%	79%
YAG-Ho	2.1 µm	74%	75%	75%

* Reflectance measurements shown represent the minimum reflectance since a black backing plate was used. Actual reflectance during use may be higher for non-black backgrounds. Reflectance measurements are 8° hemispherical reflectance (traceable to NRCC - the National Research Council of Canada) measured on a 150 mm diameter Labsphere RSA-PE-19 integrating sphere accessory on a Perkin Elmer Lambda 19 Spectrophotometer.



Typical operational scenario for laboratories, observatories, and most outdoor field sites.



Typical operational scenario for remote sensing use by airborne & spaceborne craft.

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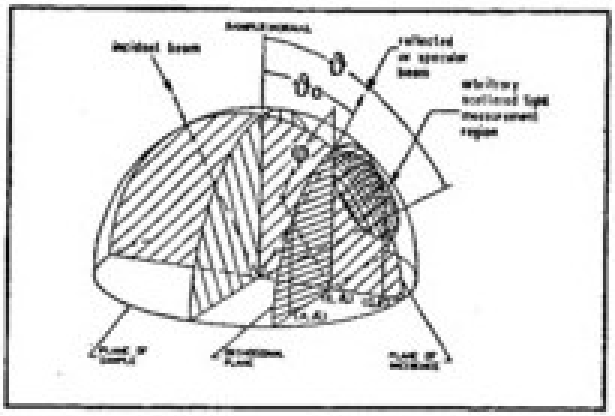
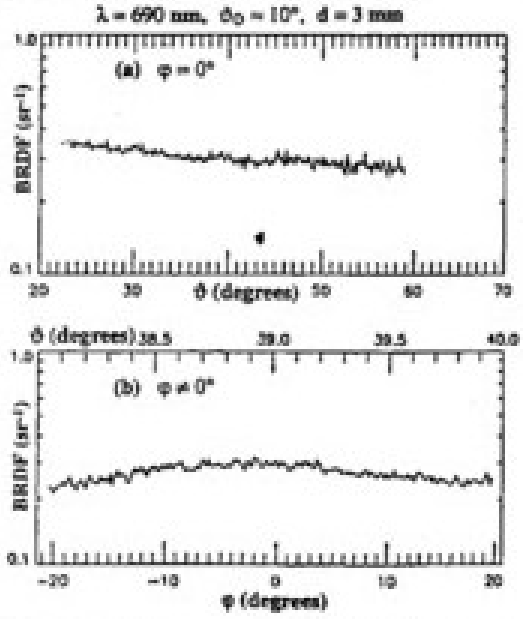
Reflectance Scattering Properties of SORICSCREEN™

SORICSCREEN™ is a diffusely reflecting surface and when used according to the directions it reflects light uniformly in all directions, even at large viewing angles with respect to the screen normal. The Bidirectional Reflectance Distribution Function (BRDF) quantifies the reflected scattered light at different angles. The data presented below shows BRDF measurements for SORICSCREEN™ (all models) at different wavelengths and scattering angles. The flatness of the BRDF curves over the range of viewing angles demonstrates that SORICSCREEN™ is a diffuse reflector even out to viewing angles approaching 90°. SORICSCREEN™exhibit similar scattering behavior at wavelengths in the UV to NIR. The BRDF measurements were taken by Breault Research Organization, Inc. (B.R.O., Inc.) (Tucson, Arizona, U.S.A.) using B.R.O.'s OMNISCATR™ scatterometer which measures reflected light in a 45 degree, 3D hemispherical cone, measuring 200,000 points with 0.1^0 resolution.

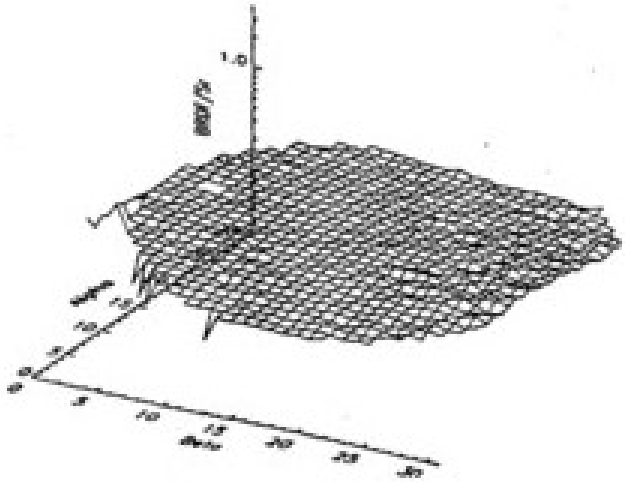
The diagram to the right shows a scatter hemisphere defined with respect to the sample plane, the sample normal, and the incident and reflected beams. For an arbitrary cone of scattered light, the plane of incidence and an orthogonal plane are shown. OMNISCATR™ records "in-plane" BRDF measurements in the plane of incidence, and "out-of-plane" measurements in the orthogonal plane. θ is the detector's in-plane angle from the sample normal, and θ_0 is the angle of incidence. ϕ is the out-of-plane angle with respect to the sample normal (ϕ=0 for in-plane measurements and $\phi \neq 0$ for out-of-plane measurements). Below, λ is the wavelength and d is the incident beam's spot size on the sample. All plots are BRDF in units of inverse steradians vs. angle in degrees. The figure on the right is courtesy of B.R.O., Inc.



(a) In-plane, and (b) out-of-plane BRDF measurements of SORICSCREEN™ (all models) at $\lambda = 690$ nm, with a source angle of incidence of θ_0=10°. The figures shown are a single cross section of the 3D hemispherical data recorded with OMNISCATR™. The BRDF curve's flatness show the screen is a diffuse reflector over a large range of viewing angles. (Measurements were taken by B.R.O., Inc. with the OMNISCATR™ scatterometer)



This is a 3D plot corresponding to an arbitrary 45 degree solid cone as shown in the above scatter hemisphere diagram. The in-plane cross sectional plot in figure (a) is the center profile of this 3D plot, along the Beta axis. The out-of-plane cross sectional plot of figure (b) is the center profile of this 3D plot, along the Alpha axis. Note the flatness of the mesh plot, which clearly illustrates the diffuse reflectance. (Measurements were taken by B.R.O., Inc. with the OMNISCATR™ scatterometer)



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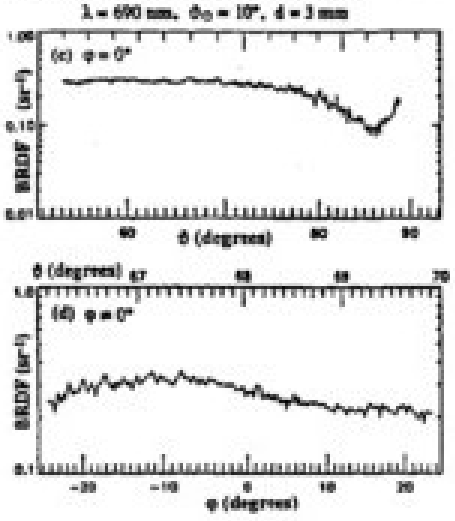
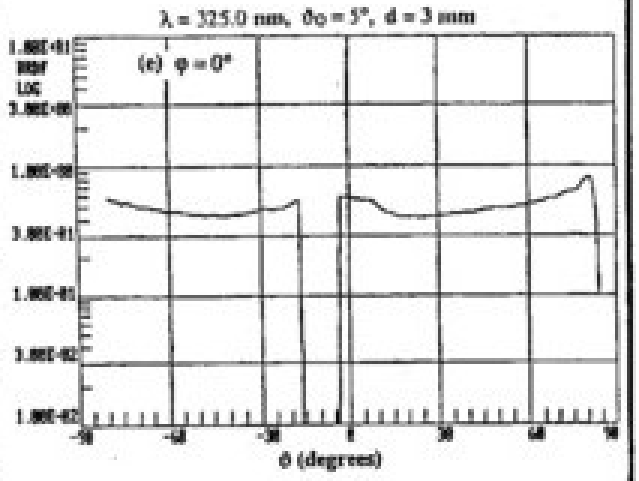
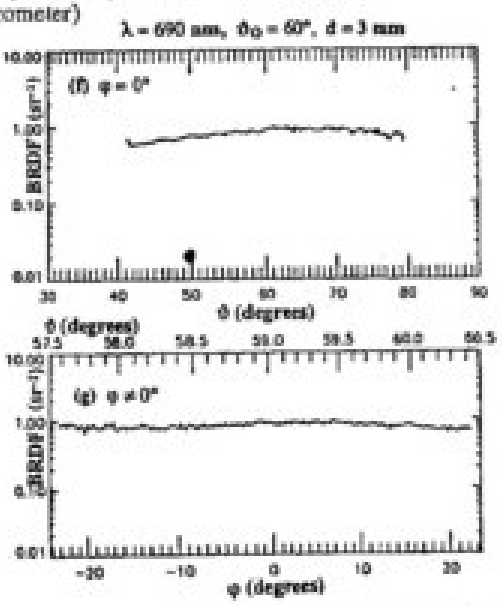
(c) In-plane, and (d) out-of-plane measurements for SORICSCREEN™ (all models) at $\lambda = 690$ nm, with a source angle of incidence of θ_O=10°. The combination of Figures (a) and (c) clearly show that since the BRDF curve is flat between about 20° and 80° that SORICSCREEN™ is a diffuse reflector. (Measurements were taken by B.R.O., Inc. with the OMNISCATR™ scatterometer)



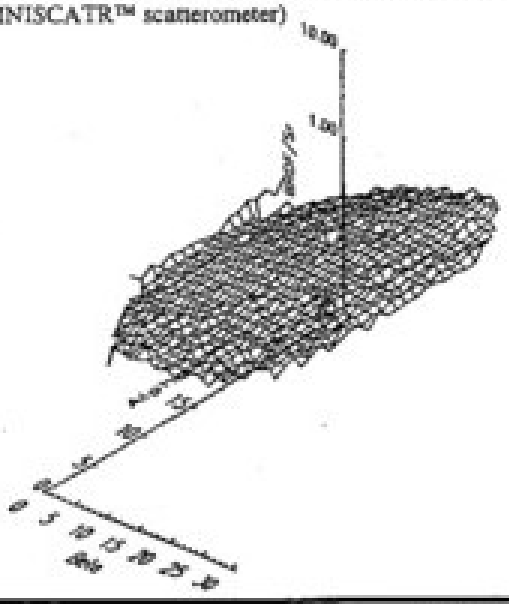
(e) In-plane measurements of a SORICSCREEN™ prototype at $\lambda = 325$ nm showing diffuse reflectance for viewing angles from -80° to +80° (similar results expected for Models 1, 2, and 3). The angular section centered around -10° is excluded because it is near θ_O. (Data taken at TMA Technologies, Inc. with the CASI scatterometer.)



(f) In-plane, and (g) out-of-plane BRDF measurements of SORICSCREEN™ (all models) at $\lambda = 690$ nm, with a source angle of incidence of θ_O=60°. The figures shown are a single cross section of the 3D hemispherical data recorded with OMNISCATR™. The BRDF curve's flatness show the screen is a diffuse reflector over a large range of viewing angles, even for sources placed at a high angle of incidence with respect to the screen. (Measurements were taken by B.R.O., Inc. with the OMNISCATR™ scatterometer)



This is a 3D plot corresponding to an arbitrary 45 degree solid cone as shown in the above scatter hemisphere diagram. The in-plane cross sectional plot in figure (f) is the center profile of this 3D plot, along the Beta axis. The out-of-plane cross sectional plot of figure (g) is the center profile of this 3D plot, along the Alpha axis. Note the flatness of the mesh plot, which clearly illustrates the diffuse, Lambertian-like reflectance even when the source is placed at a high angle of incidence to the screen (θ_O=60°). (Measurements were taken by B.R.O., Inc. with the OMNISCATR™ scatterometer)



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Standard Sizes of SORICSCREEN™

Size #	Screen Viewing Area Size	
	Dimensions in inches and feet:	Dimensions in meters:
1	8 x 8 inches (0.67 x 0.67 feet)	0.20 x 0.20 meters
2	16 x 16 inches (1.33 x 1.33 feet)	0.41 x 0.41 meters
3	33 x 33 inches (2.75 x 2.75 feet)	0.84 x 0.84 meters
4	66 x 66 inches (5.5 x 5.5 feet)	1.68 x 1.68 meters
5	99 x 99 inches (8.25 x 8.25 feet)	2.52 x 2.52 meters
6	132 x 132 inches (11.0 x 11.0 feet)	3.35 x 3.35 meters
7	165 x 165 inches (13.75 x 13.75 feet)	4.19 x 4.19 meters
8	198 x 198 inches (16.5 x 16.5 feet)	5.03 x 5.03 meters
9	231 x 231 inches (19.25 x 19.25 feet)	5.87 x 5.87 meters
10	264 x 264 inches (22 x 22 feet)	6.71 x 6.71 meters
11	297 x 297 inches (24.75 x 24.75 feet)	7.54 x 7.54 meters
12	330 x 330 inches (27.5 x 27.5 feet)	8.38 x 8.38 meters
13	363 x 363 inches (30.3 x 30.3 feet)	9.24 x 9.24 meters
14	396 x 396 inches (33 x 33 feet)	10.06 x 10.06 meters
15	**Smaller, larger & intermediate sizes (& non-square shapes) available as custom orders**	

About Stellar Optics Research International Corporation (SORIC)

Stellar Optics Research International Corporation (SORIC) specializes in products and services related to black, white, and reflective surfaces and materials employed within and viewed by ground and space-based instrumentation. SORIC manufacturers SORICSCREEN™, a white, ultraviolet to near infrared white screen product for observatory, laboratory and field use. SORIC has accumulated, from formerly proprietary sources, the world's largest databank of Reflectance and Bidirectional Reflectance Distribution Function (BRDF) data for black, white, reflective and transmissive surfaces and materials, with initial seed funding from the Canadian Space Agency. SORIC's databank is being turned into a commercial software database product, which will emphasize the BRDF and Reflectance data. SORIC collaborates with its 18-member panel of International Expert Advisors to create the database. Until the database product is finished SORIC releases the data to the community through data distribution services and customized database creation. SORIC's related services include black, white, and reflective surface and materials selection; optical thin film coating and filter design; and stray light analysis and the design of optical systems. SORIC works with its commercial, government and university customers to design, troubleshoot, and optimize the performance of their ground and space-based optical systems.

SORIC was founded in 1992 by Dr. S. McCall, a specialist in black and white surfaces, and optical coatings and filters. SORIC offers advanced technology and expertise, and it is dedicated to solving complex problems and giving its customers a competitive advantage. SORIC is a member of the Institute for Space and Terrestrial Sciences (Ontario, Canada), and the Ontario Aerospace Council (Ontario, Canada) and Dr. S. McCall is a member of the SPIE, the International Society of Photo Optical Instrumentation Engineers.

Thank you for your interest in SORIC products and/or services.
For product and sales information please contact SORIC at:

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Internet: soric@csr.ists.ca

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