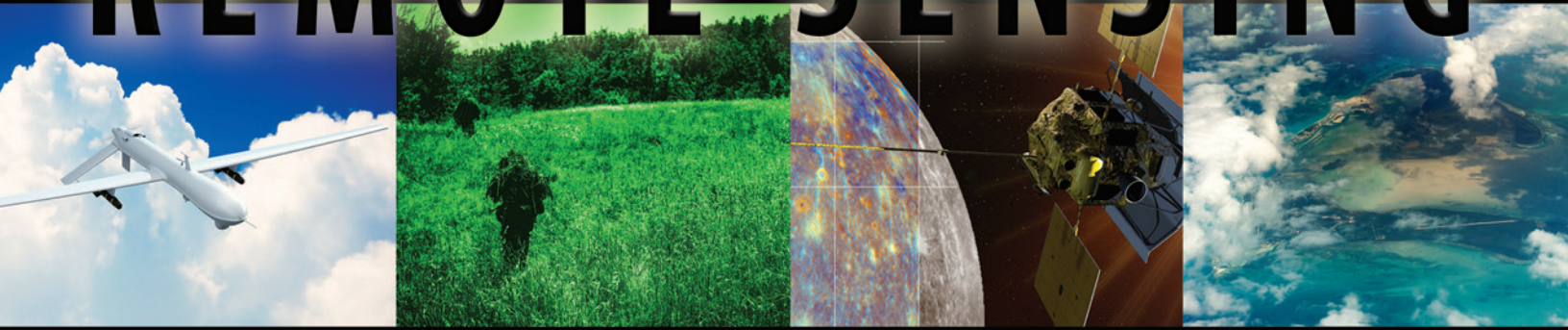


REMOTE SENSING



Ground, Aerial, Vacuum and Space Systems Capabilities

Traceable Testing Solutions:
200 - 2500 nm (UV/VIS/NIR/SWIR)

Bare Sensor/CCD/CMOS Testing

Imaging Camera/Sensor Testing

Flat Fielding / Non-Uniformity Correction

Linearity & Dynamic Range Testing Solutions

Signal-to-Noise (SNR) Characterization
or Night Vision Levels

Target Illumination (PSF, MTF, Keystone,
Edge-effects, etc.)

Hyper & Multi Spectral Calibration Solutions

Quantum Efficiency Testing Solutions
(Spectral or In-Band)

Spectral "Blending" of Light Sources
(LED, Lasers & Xenon/Tungsten)



www.labsphere.com

DELIVERING SOLUTIONS

**Develop solutions that fit
your chip, module, camera
or telescope needs**

**Discuss testing procedures
to get best possible uncertainty
and test methods for your
products**

**Determine a level of optical
performance, automation,
accuracy and speed to meet
today's challenging applications
in remote sensing**

**Determine product performance
at a lower level in the value
chain to maximize your yields
and standardize/characterize
product output**

**Engineer and build a solution
with our experts to meet
your budget**

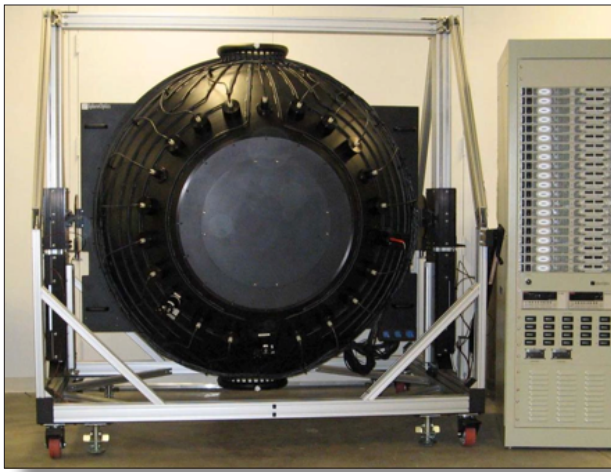
Labsphere is the world's premier source for ground-based calibration systems for large earth observing satellites, imaging systems and remote sensing optical calibration solutions. We are the world leader in sphere-based uniform source system design and implementation. We are committed to always being on the cutting edge in measurement uncertainty and system performance that enables the next generation of remote sensing, climate science, military hardware and tactical calibration. We can operate traceably in any test environment condition from vacuum to ambient and over a wide range of temperatures.

In addition to our highest performing systems, we offer a modular and flexible product line that enables us to engineer product to your specific test problems, uncertainty requirements and budget. We offer broadband, solar-like, vacuum compatible and spectral source solutions that focus on everything from FPA or chip level testing to finished telescopes and all levels of product in between. Our solutions range from simple manual systems to fully automated/software integrated production test systems that engage with your product at frame-grabber, FPA, camera or prober level. Our staff is current on all testing standards (EMVA-1288, MIL, and others) and we are NIST-traceable for source system calibrations.

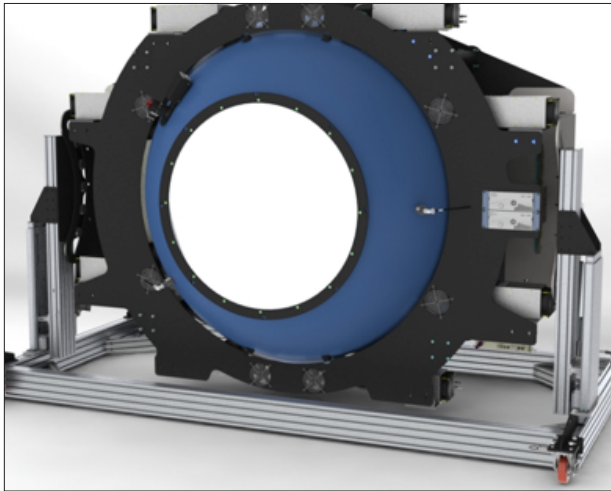
Let us help you build your laboratory, obtain compliance and bring your products under your control in the fast moving world of remote sensing, military imaging systems, scientific imaging and machine vision.



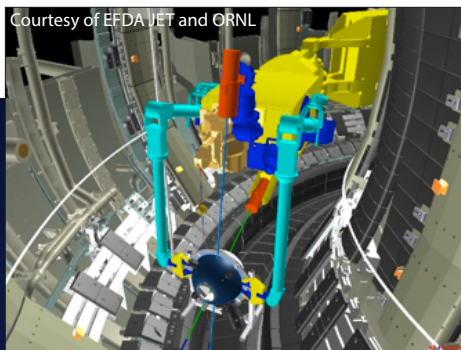
GROUND-BASED IMAGER OR SENSOR TESTING:



1.5 m, 11kW Water-Cooled, N2 Purged Calibration System



9kW Xenon and 6kW QTH 2 m Calibration System
for Albedo 0+ Spectrums



Courtesy of EFDA JET and ORNL

12 in System for
Harsh Environment
Tokamak Sensor
Calibration



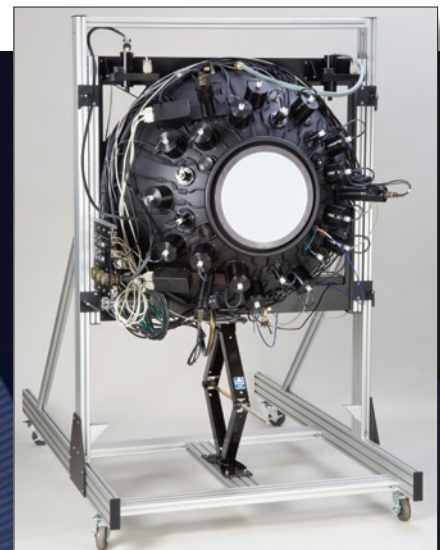
26 in Geodesic Spectralon SIRCUS (Laser)
Calibration Sphere for NASA

Solutions for ground-based testing are driven by the needs and testing of today's cutting edge satellites, terrestrial and airborne imaging systems.

Incredible dynamic range, solar spectrums, precision multi-band and spectral monitoring and most of all unprecedented levels of low uncertainty are the hallmark of the science and military remote sensing programs today.

Whether you are trying to understand weather and climate changes, investigating hyperspectral applications or have specific tactical requirements, Labsphere can build a test system that will suit your needs.

Solutions are available for a huge range of aperture sizes:
<25 mm to >2 m.



9kW, 7-Decade
Dynamic Range,
Water-Cooled
Ground-Based
Optical Calibration
System

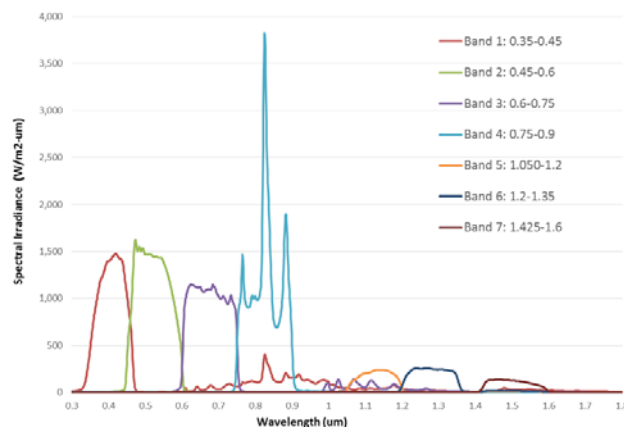
INNOVATIVE SPECTRUMS:

An ideal calibration source is a uniform, spectral signature identical to the target(s) of interest: top of atmosphere as reflected from clouds, snow, deserts, forests or ocean surfaces. Labsphere furnishes a wide range of sources to meet these spectral requirements including:

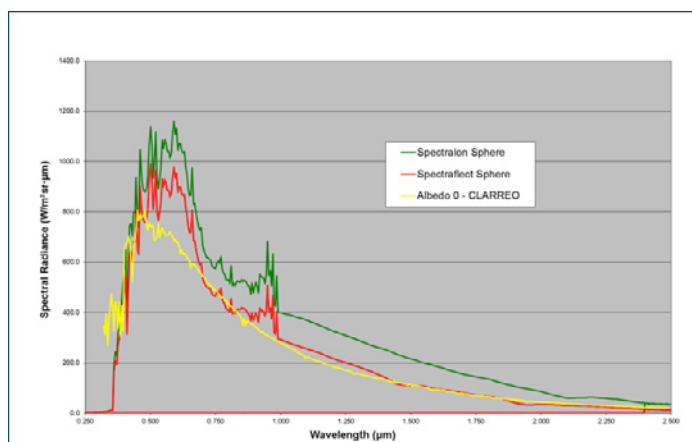
- Tungsten halogen
- Xenon
- Electrodeless plasma sources

Tungsten halogen lamps are still the staple of most optical calibration programs and instruments and spheres are no exception.

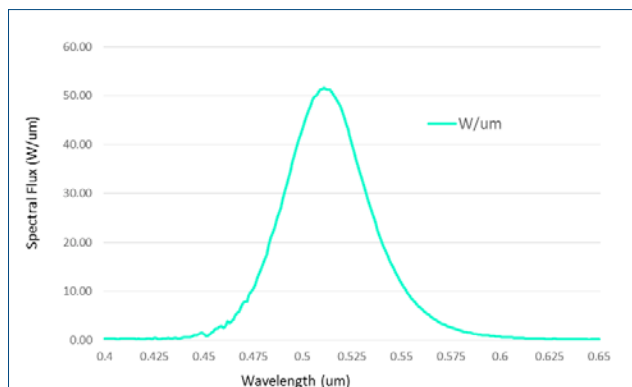
Labsphere regularly seeks solutions with more solar-like spectrums to improve blue and UV band signal ratios to provide spectrums that are almost spectrally identical to terrestrial or even extra-terrestrial solar sources.



Class A Band-Tuneable Solar Simulator



Example Spectral Radiance of QTH and Plasma Source in Spheres



Blue-Green High Flux LED Input to Sphere

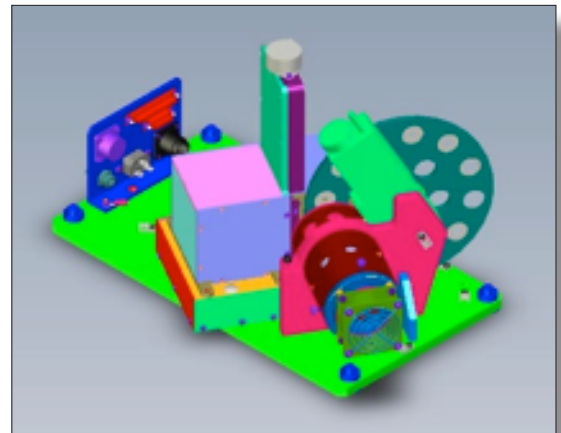
Labsphere has conducted feasibility studies on challenging sources for NASA to find spectrums that can be used to simulate flight conditions. With today's hyperspectral and multi-band system requirements even more band-selectable sources such as lasers and blue or UV LEDs are becoming critical to testing needs. Labsphere has also created spectrally tuneable sources using combinations of the above referenced materials. Let us help you with your custom spectral requirement applications.

AIRBORNE CALIBRATION SOLUTIONS:

The need for precise radiometric solutions for aerial reconnaissance and imaging is steadily increasing with the advent of Unmanned Aerial Vehicles (UAVs) and more detailed image requirements in a variety of challenging tactical environments. Science has also taken to the air with hyperspectral, LiDAR and spectral sensing applications that require accurate calibration and portability to remote locations.

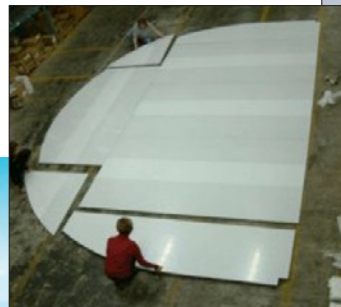
Labsphere can create a variety of field-based solutions for real-time calibration:

- Custom onboard solutions for real-time radiometric verification in aircraft
- Large, weather resistant targets used at-site for ground truth measurements
- Mobile sphere system solutions that sit in the hangar ready to deploy for fast calibration and certification needs.



Airplane Fuselage Multi-Band Calibration Source for Reconnaissance Applications

Ruggedized Hyperspectral Calibration Source for Hangar and Runway Deployment

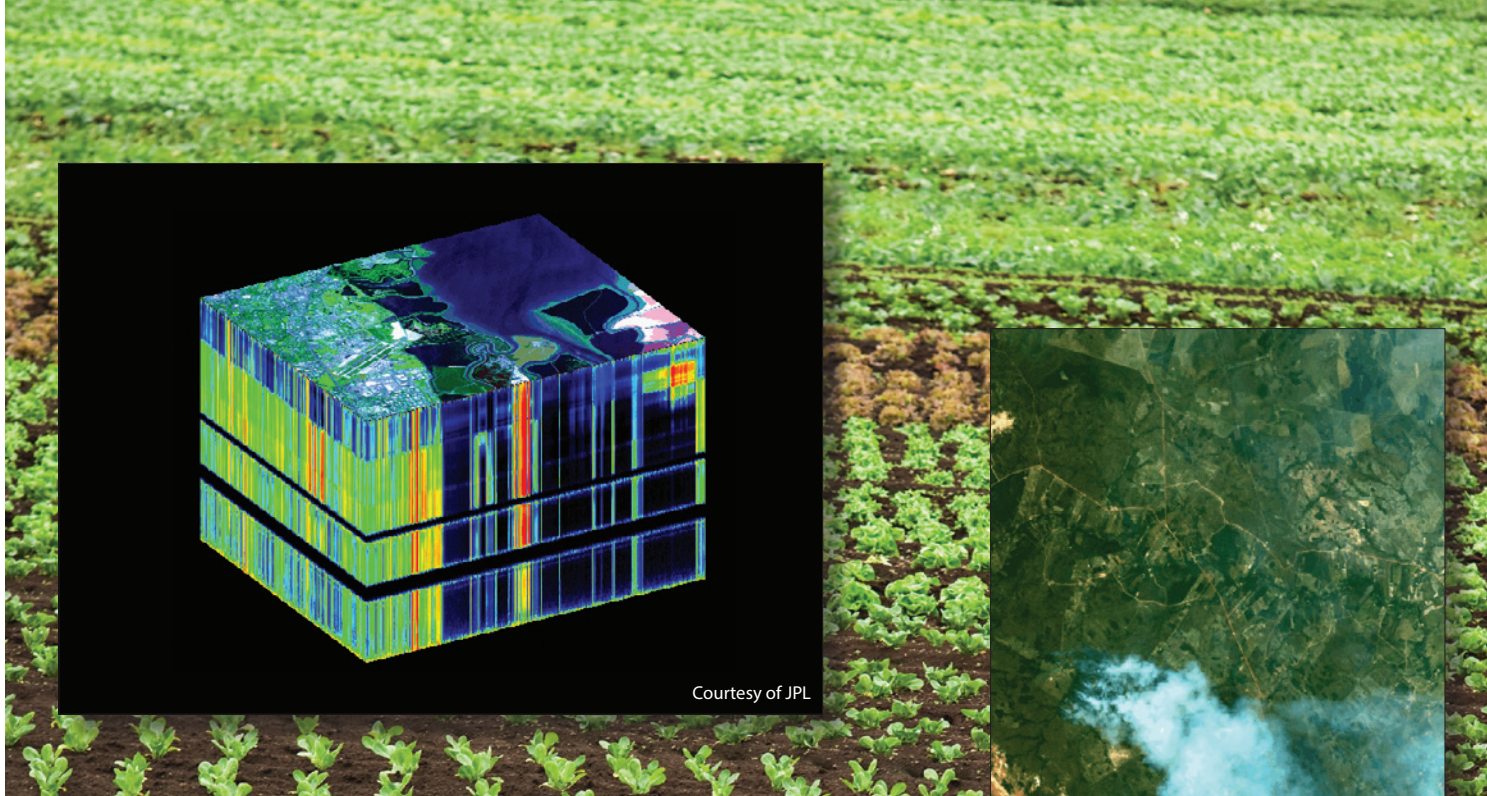


Lightweight, Modular, Large Area Lambertian Calibration Target



Classic Spectralon Target for Spectral Ground Truth Reflectance



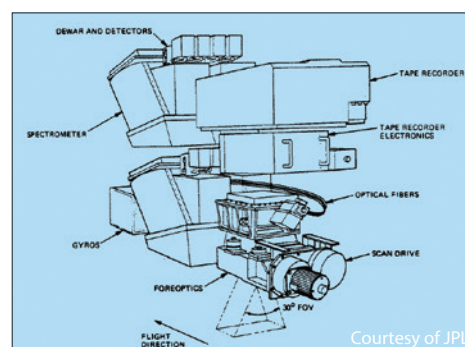
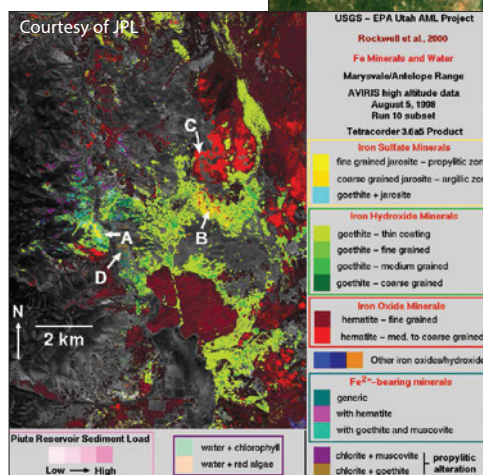


HYPERSPECTRAL CALIBRATION SOLUTIONS:

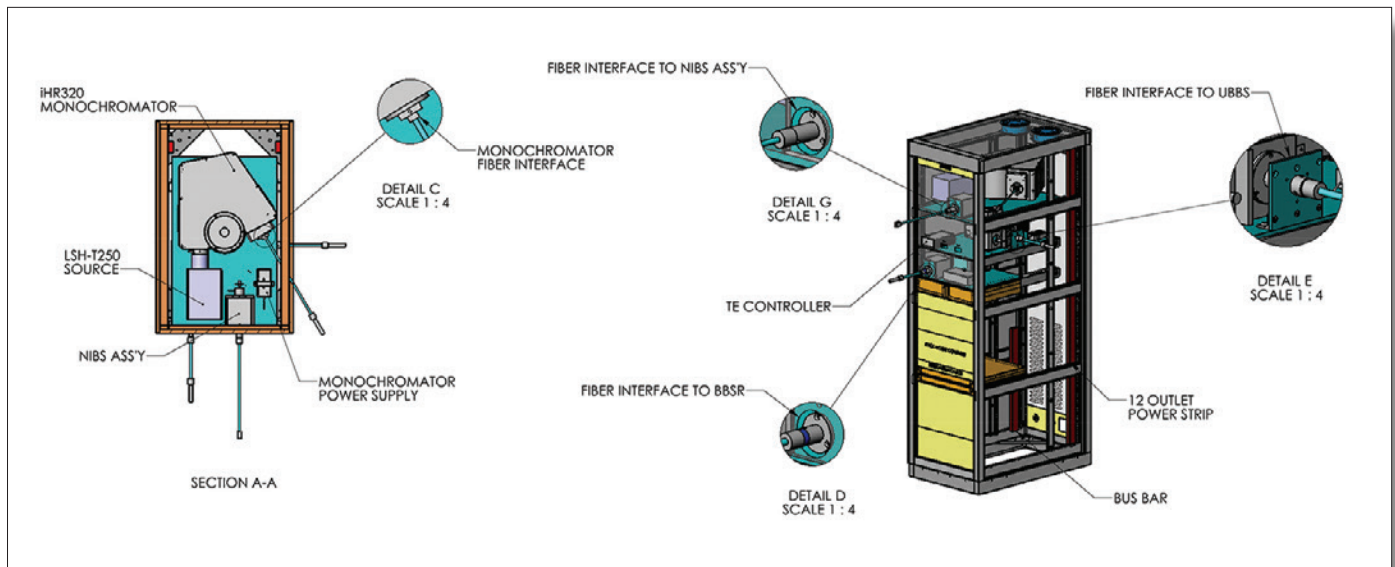
One of the most dynamic changes to the remote sensing market is the innovation of hyperspectral imagers. These challenging devices combine a conventional 2D image with a third dimension containing spectral or band information to create a "hyper-cube". Calibration also gets a third dimension of complexity in dealing with simultaneous imaging issues, broadband scenes, spectral registration and stray light (in and out of band) considerations.

Labsphere can create complete, absolute calibration systems that combine broad spectrums, monochromatic or line sources, and high dynamic ranges to meet the requirements of this new and rapidly evolving technology.

Images and a Hyper-cube
from Systems for
Agriculture, Aerosols
from Fires, and Mining
Applications

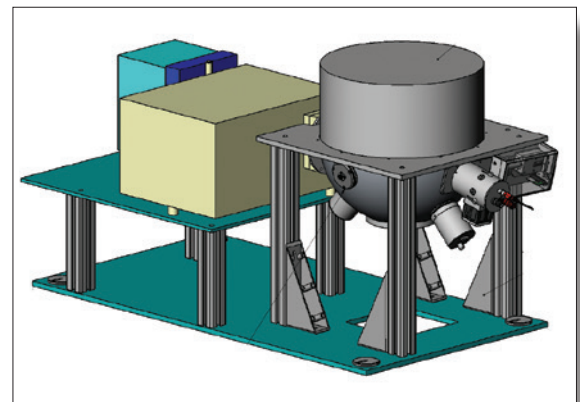


AVIRIS Hyperspectral Instrument – One of the Forerunners
of Today's Compact, Commercial and Military Solutions



Absolute, Fiber-Based Uniform Spectral and Broadband Illuminator for Image FPA on Prober Station

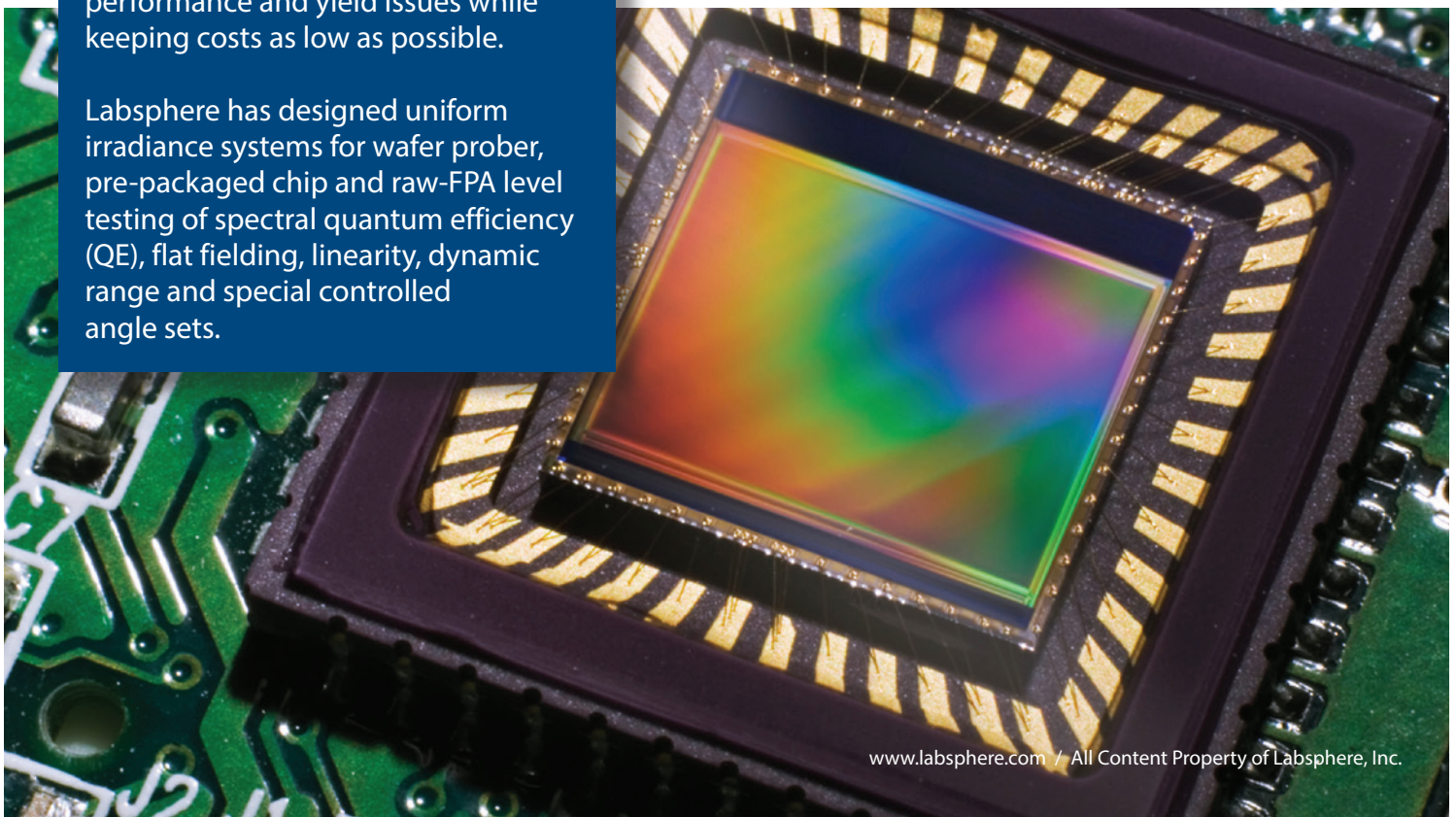
QUANTUM EFFICIENCY FOR FPA OR PROBER BASED SOLUTIONS:



Fixed F# Spectral-Broadband Irradiance Sphere System
for Packaged FPAs

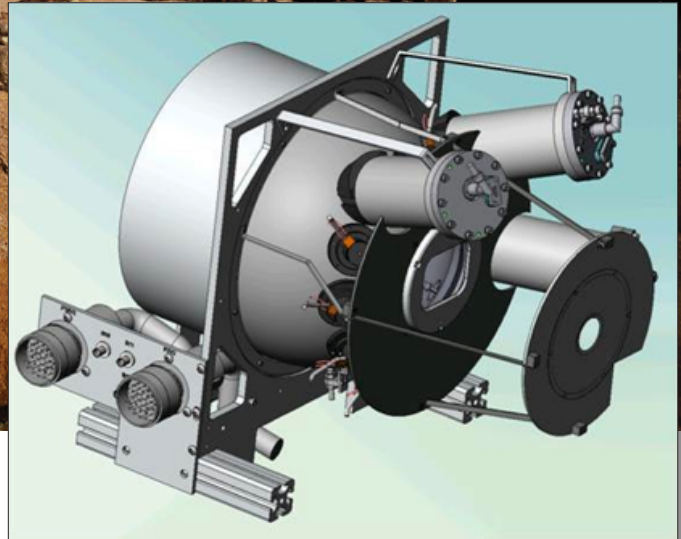
Baseline characterization of FPAs and imaging chips is required at the earliest possible point in production helping to sort out critical performance and yield issues while keeping costs as low as possible.

Labsphere has designed uniform irradiance systems for wafer prober, pre-packaged chip and raw-FPA level testing of spectral quantum efficiency (QE), flat fielding, linearity, dynamic range and special controlled angle sets.

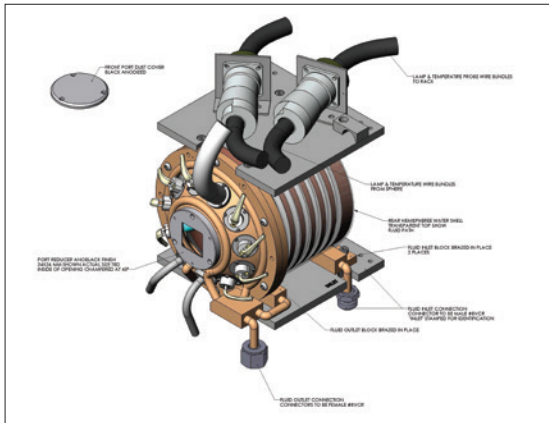


VACUUM AND THERMAL VACUUM SOURCE SYSTEMS:

How do you achieve the lowest possible uncertainty?
Test as you Fly and Fly as you Test.
For space systems that means leaving the ambient realm for the most aggressive environment we know: the vacuum and temperature ranges of space. Labsphere specializes in creating optical uniform sources in vacuum environments. Our materials, spheres, light sources and detectors can be designed for vacuum compatibility and stable, traceable radiometric performance.



In Vacuum FPA, Fixed F# Illumination Source



In Vacuum, Absolute
Multi-Level, Multi-Band
Target Source for OAP



Vacuum, 1.5m LN2 Cooled 8kW Absolute Uniform Source
Descending into NASA 3m TV Chamber

SPACE-GRADE SPECTRALON®

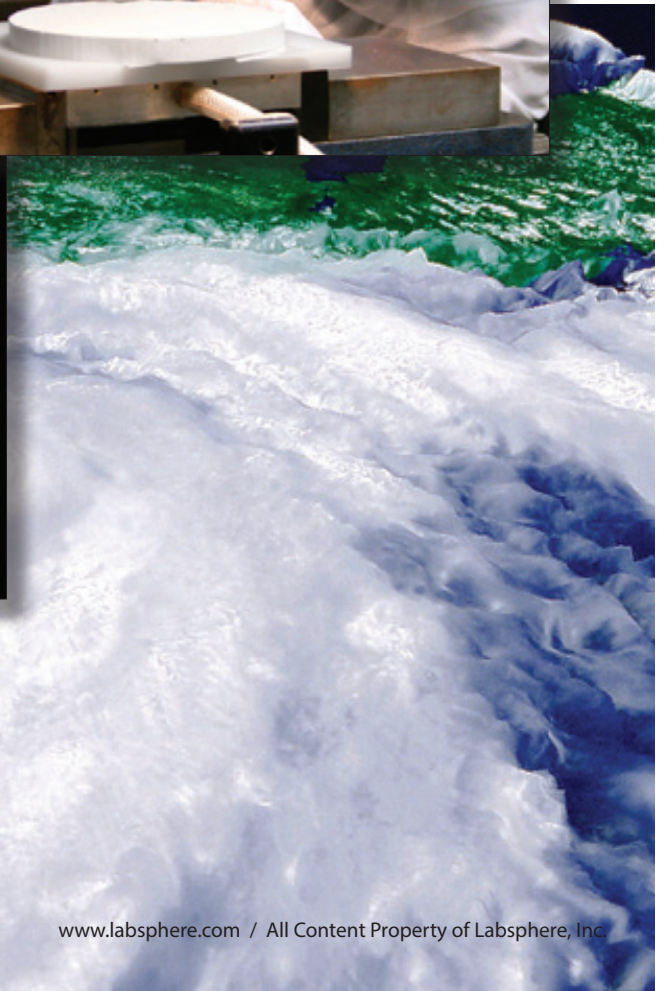
Spectralon is a proprietary diffuse reflectance material which provides extremely stable, reproducible spectral reflectance.

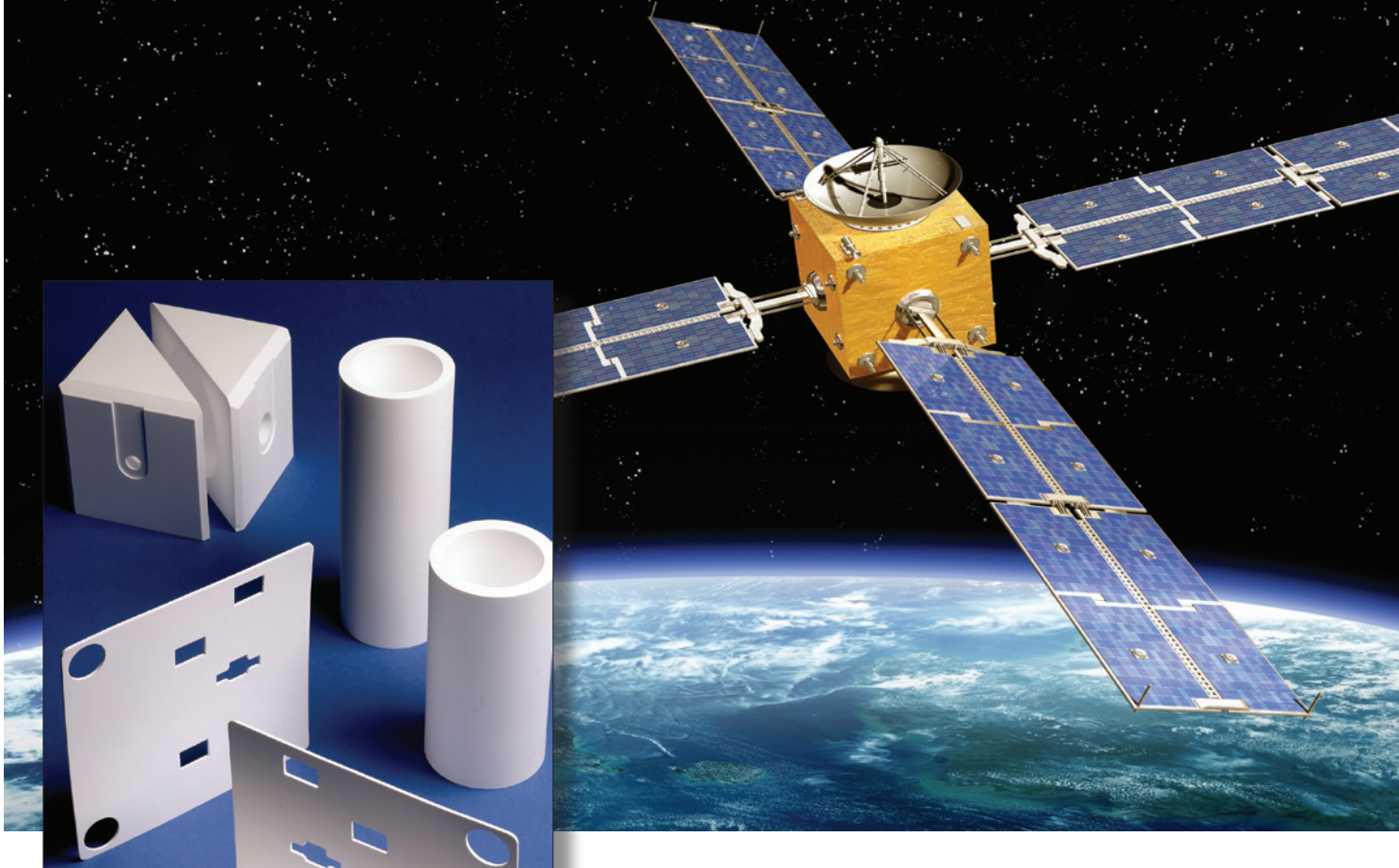
The material offers the highest diffuse reflectance of any known reflectance coating or material over the UV-VIS-NIR wavelength region. Spectralon is extremely Lambertian, chemically inert, and thermally and environmentally stable.

With these properties it has become the material of choice as a reflectance standard in the international remote sensing community for both field and laboratory applications.

Space-grade Spectralon material exhibits reflectance values of ~98% over the wavelength range from 300 to 2000 nm and ~95% reflectance over the wavelength range from 250 to 2500 nm. The material is developed under stringent manufacturing processes in a clean-room environment to ensure extraordinary performance and product reliability necessary for space applications.

Space-grade Spectralon has undergone extensive testing for UV exposure, proton bombardment, atomic oxygen exposure, a-Lyman radiation, outgassing and static charge testing by national laboratories, such as NASA Goddard, Jet Propulsion Laboratory, DLR, NIST, CNES, CSL, ESA, JAXA and many others world wide. This testing has led to the development of a stringent manufacturing process that eliminates potential contaminants that can lead to UV degradation.



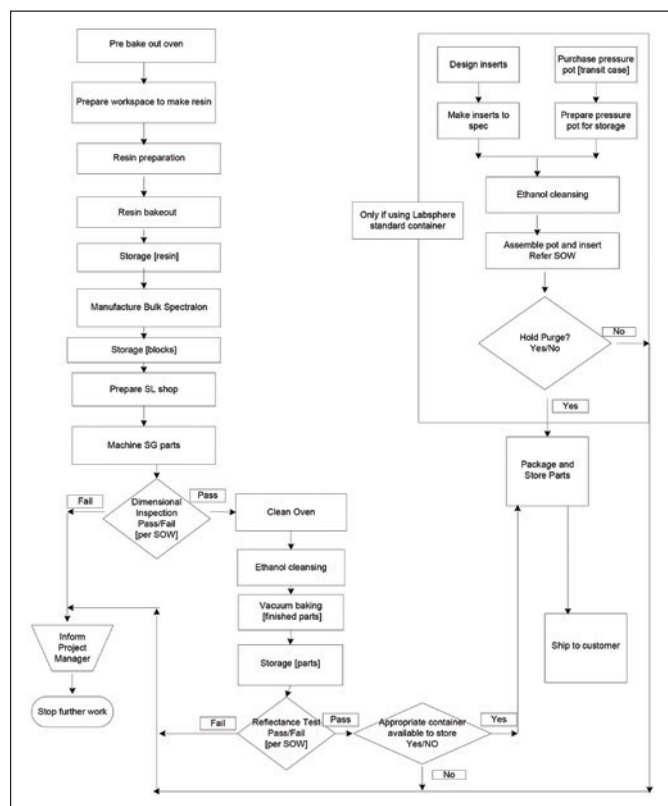


Space-grade Spectralon is a critical optical reference material for over a dozen platforms and is in operation on the following orbital programs:

Instrument	Mission
MERIS	EnviSat
GLI-I	ADEOS ii
MODIS	Terra & Aqua
MISR	Terra
VIIRS	Suomi NPP

Space-grade Spectralon material is developed under an advanced manufacturing process. The process involves special cleaning and baking procedures, rigid inspection, special handling and packaging and full documentation processes. Each sample coupon undergoes rigorous mechanical and spectroscopic analysis. The material packaging process includes specially machined sample containers, nitrogen purging, and custom shipping containers to protect the material against molecular and particulate contamination. Each step of the manufacturing and handling process ensures that the material is of the highest purity and cleanliness, essential for space applications.

FLOWCHART OF SPACE-GRADE PROCESS



CALIBRATION AND TRACEABILITY:

Labsphere offers an extensive range of calibration capabilities and expertise to meet your program needs.

Many of our products and services are traceable (highlighted in yellow) or NVLAP* accredited under NVLAP Lab Code 200951-0 (highlighted in green):

TYPES OF UNIFORM SOURCE SYSTEM CHARACTERIZATIONS	Luminance Meter	Colorimeter	Illuminance Meter	Spectral Radiometer	Double Monochromator	PMT Photometer/Colorimeter	Uniformity Mapping Station	Angular Mapping Station	Filtered Detector	Laser Power Measurement	Electrical Calibration Station	Engineering Services	Portable Calibration Source	Sphere-based Spectral Flux	CMM	d/8 Spectrophotometer	Vacuum Oven	UV Irradiance Station	BRDF Instrument	Custom Solutions
LUMINANCE	X	X		X	X	X	X	X												X
ILLUMINANCE @ DUT PLANE			X				X		X											X
ANGLE LIMITED (F/#) RADIANCE OR IRRADIANCE																				X
COLOR TEMPERATURE		X				X	X	X												X
SPECTRAL RADIANCE				X	X															X
SPECTRAL IRRADIANCE @ DUT PLANE				X	X															X
BAND SELECTED RADIANCE/IRRADIANCE										X										X
SPATIAL UNIFORMITY	X	X	X	X		X	X		X											X
ANGULAR UNIFORMITY	X	X		X		X		X												X
TEMPORAL STABILITY	X	X	X	X	X	X			X		X									X
SPECTRAL STABILITY				X	X															X
SPECTRAL MATCHING OF LAMPS		X		X	X	X														X
LOW LEVEL (NIGHT VISION)					X	X														X
ON-SITE CALIBRATIONS				X			X	X			X		X							X
ELECTRICAL CALIBRATIONS											X		X							X
DYNAMIC RANGE MEASUREMENT	X	X	X	X	X	X			X		X									X
LUMINOUS FLUX														X						X
SPECTRAL FLUX														X						X
SPECTRAL REFLECTANCE																X				X
BRDF																			X	X
VACUUM BAKEOUT																	X			X
UV IRRADIANCE STABILITY																		X		X
FIDUCIAL & DIMENSIONAL MEASUREMENT															X					X
THERMAL MODELING PERFORMANCE (STABILITY)												X								X
MECHANICAL SHOCK/VIBRATION												X								X

* ISO/IEC 17025:2005

SOFTWARE CAPABILITY:

Labsphere offers standard and custom software solutions for our uniform source systems.

Please contact our staff with your requirements to outline a solution. We are experts at system control in LabVIEW, C-Languages, Python and other architectures.

LABSPHERE REMOTE SENSING ENGINEERING TEAM:



Dan Scharpf, Ph.D. – Director of Engineering

Dan received his B.S. from the University of Dayton in Mechanical Engineering, followed by his Masters and Ph.D. in Aerospace Engineering from the University of Notre Dame. His work experience includes Boeing, Fluent Inc., Southwest Research Institute and DEM Solutions. His technical background covers experimental and numerical analysis of fluid mechanics, rotating machinery, thermal analysis and acoustics.



Angelo Arecchi – Manager of Special Projects

Angelo was the Director of Systems Engineering at SphereOptics and VP of Engineering at Labsphere. Angelo holds an MS degree in Optics from the University of Rochester, an MBA from Plymouth State University, and is a registered Professional Engineer. He is the principal author of the SPIE Field Guide to Illumination and a member of SPIE, OSA, CIE, IESNA, and CORM, the Council for Optical Radiation Measurements.



Chris Durell – Remote Sensing Product Manager

Chris graduated from Cornell University with an BSEE in 1993 and finished his MBA at Franklin Pierce College in 2003. Chris was the VP of Sales for both Labsphere and SphereOptics and has led efforts to design optical, light measurement and remote sensing systems and technology for over 15 years. He is a member of SPIE, IES, ASTM. He has several patents and has published papers in many applications of light metrology.



オーシャンフォトニクス株式会社 営業部 ラブスフェア課
東京都新宿区西早稲田 3-30-16 ホリゾン 1 ビル

TEL: 03-6278-9470 FAX: 03-6278-9480

URL: <http://www.oceanphotonics.com> E-mail: sales@oceanphotonics.com