Primary Standards Laboratory
Optical Project

Fact Sheet

The Primary Standards Laboratory (PSL) maintains a variety of primary optical standards to assure accurate and traceable measurements for its customers.

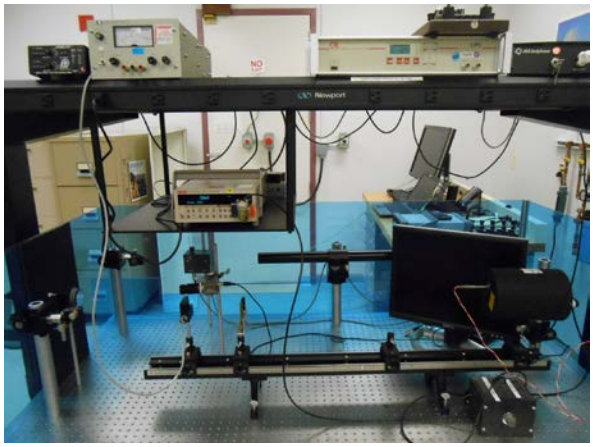
Primary optical standards are directly traceable to the Systeme International through the National Institute of Standards and Technology (NIST). Primary optical power and energy standards are based on heat-flow calorimetry, while spectral responsivity is based both on NIST-certified and "absolute" Si detectors.

Laser power in the range 1 mW–10 W is measured with a heat-flow calorimeter that is certified based on NIST calibration, electrical substitution calibration, and comparison with an "absolute" Si detector. Wavelengths in the range 0.25–10.6 μm can be used, though reflectivity corrections must be made at 10.6 μm. The standard is used with various lasers to certify customer laser power meters.

Laser welding power meters for the range 10–1000 W are calibrated using a water-cooled calorimeter standard and a customer-supplied laser. The standard is calibrated at NIST at high powers and is cross-checked against the heat-flow calorimeter at 10 W. Both YAG and CO_2 lasers can be used, either pulsed or CW. Beam energy in a single pulse is measured from the average power and the repetition rate.

Laser pulse energy meters for Q-switched YAG lasers are measured against a standard using the customer's laser as the source. The standard is calibrated using both electrical pulses and optical pulses extracted from a CW beam using a shutter. The present useful wavelength range is 0.4 –1.2 μm, and the energy range is 2 mJ to 1 J.

The standard of solar power (insolation) is another calorimeter designed for outdoor use and calibrated against the low-power laser standard, the World Radiation Reference, and by electrical substitution. This calorimeter is used to calibrate a pyrheliometer by direct comparison while both are tracking the sun.



Laser Power Meter Calibration

Pyranometers, which measure the light from the full sky, are calibrated vs. the calorimeter using a shading technique. Customer devices are certified using the working standard pyrheliometer or pyranometer.

Spectral responsivity of customer devices is measured using a monochromator source and an Si standard detector in the solar systems department at Sandia National Laboratories (SNL). The standard, in turn, is calibrated against similar NIST-certified detectors over the wavelength range 0.3–1.1 μm and against "absolute" Si detectors over their limited range of applicability (0.4–0.7 um).

The working ultraviolet meter for measuring the irradiance at the 365 nm line of Hg is calibrated against the laser power meter. Light is provided by an Hg-Xe lamp and monochromator setup, and customer UV meters are calibrated by substitution. Irradiances between 50 and 1000 $\mu W/cm^2$ can be provided.

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Capabilities

Laser Power	Uncertainty (k=2)
1 mW to 10 W	0.5%
10 to 1000 W	4%
Laser Pulse Energy	3%
Solar Power	
Pyrheliometer	2%
Pyranometer	4%
Spectral Responsivity	2%
UVMeter (365 nm)	10%

Contacts

Alan J. Nelson, Ph.D.
Project Lead
Sandia National Laboratories
P. O. Box 5800; M/S 0665
Albuquerque, NM 87185-0665
Phone: (505) 284-1720
FAX: (505) 844-4372
Email: anelso@sandia.gov

Meaghan Carpenter
Manager
Sandia National Laboratories
P. O. Box 5800; M/S 0665
Albuquerque, NM 87185-0665
Phone: (505) 284-8268
FAX: (505) 844-4372
Email: mscarpe@sandia.gov

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