SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

NATIONAL RENEWABLE ENERGY LABORATORY (NREL)
PV Cell and Module Group, Broadband Outdoor Radiometer Calibration (BORCAL) Group & Spectral Irradiance Group (SIG)
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CALIBRATION

Valid To: November 30, 2016 Certificate Number: 1239.02

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following calibrations[1]:

I. Optical Quantities

Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
Primary Photovoltaic Reference Cells –			ASTM E1125 with:
DC Current	(0.1 to 200) mA	0.91 %	Agilent 34401, precision resistor
Photovoltaic Reference Cells –			ASTM E948, IEC 60904-1 (Sec. 4) with:
DC Voltage	(0.1 to 40) V	0.2 %	Agilent 34410
DC Current	1 mA to 15 A	1.1 %	Agilent 34410 precision resistor
Power	1 mW to 600 W	1.2 %	Agilent 34410
Area	(0.5 × 0.5) cm to (20 × 20) cm	0.1 %	Nikon-NEXIV

Parameter/Equipment	Range[4]	CMC[2, 3, 5] (±)	Comments
Photovoltaic Reference Modules –			ASTM E1036, IEC 60904-1 (Sec. 4) with:
DC Voltage	(0.4 to 290) V	1.2 %	Agilent 34401
DC Current	(0.1 to 50) A		Agilent 34401, precision resistor
	A ≤ (30 × 30) cm A > (30 × 30) cm	1.6 % 3.2 %	
Power	50 mW to 1200 W		Agilent 34401
	A ≤ (30 × 30) cm A > (30 × 30) cm	1.9 % 3.3 %	
Area	(1 × 1) cm to (160 × 125) cm	0.7 %	Tape measure
Broadband Outdoor Radiometer Calibration –			
Pyranometers –			
Irradiance Level: Direct Beam ≥ 700 W/m^2 ± 0.35 %	Minimum Zenith Angle Range: Up to 30º (30 to 60)°	 0.6 % 1.2 %	Traceability: SI, through World Radiometric Reference (WRR)
Diffuse: 10 W/m^2 to 150 W/m^2 ± (2.6 % + 1 W/m^2)	Maximum Zenith Angle Range: (16.5 to 80)°		Reference irradiance: the outdoor direct beam irradiance from the sun disk and the diffuse irradiance
Pyrheliometers –			
Irradiance Level: Direct Beam ≥ 700 W/m^2 ± 0.35 %	Minimum Zenith Angle Range: (30 to 60)° Maximum Zenith Angle Range: (16.5 to 80)°	0.78 %	

Parameter/Equipment	Range	CMC[2, 3] (±)	Comments
Spectral Irradiance –			ASTM G138 w/:
Spectroradiometer (250 to 2400) nm	250 nm 350 nm 450 nm 555 nm 655 nm 900 nm 1600 nm 2000 nm 2300 nm 2400 nm	2.1 % 1.7 % 1.4 % 1.4 % 1.3 % 1.3 % 1.2 % 1.2 % 1.2 % 1.6 %	NIST spectral irradiance standard 1000 W FEL lamp

[1] This laboratory is conditionally available for commercial service.

[2] Calibration and Measurement Capability Uncertainty (CMC) is the smallest uncertainty of measurement that a laboratory can achieve within its scope of accreditation when performing more or less routine calibrations of nearly ideal measurement standards or nearly ideal measuring equipment. CMCs represent expanded uncertainties expressed at approximately the 95 % level of confidence, usually using a coverage factor of $k = 2$. The actual measurement uncertainty of a specific calibration performed by the laboratory may be greater than the CMC due to the behavior of the customer's device and to influences from the circumstances of the specific calibration.

[3] In the statement of CMC, percentages are percentage of reading, unless otherwise indicated.

[4] Zenith angle range of calibration of the NREL location will vary with the day of year and sky conditions during the calibration event, and are limited to the zenith angle ranges listed on the scope of accreditation. In addition, the maximum zenith angle range might change during the calibration event due to the irradiance level limitation.

[5] The uncertainty resulting from the UUT's performance outdoor will be added (RSS) to the uncertainty of the nominal values; therefore the combined uncertainty will vary based on the instrument model, serial number, and the reported environmental conditions during the calibration event.