

Centro n° 225:

JOINT RESEARCH CENTRE ESTI - European Solar Test Installation

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Tabella allegata al Certificato: **225 rev. 00**

Responsabile: **dott. Ewan Duncan DUNLOP**
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Settori accreditati: **1**

Permanent Laboratory

SCOPE OF ACCREDITATION

Calibration field	Calibration objects	Quantity, property	Reference to standardised procedure	Internal calibration procedure reference	Calibration and Measurement Capability (CMC)
TCO - Determination of the temperature coefficients of current and voltage of PV devices – Indoor.	Photovoltaic device (cell or module)	Irradiance (W/m ²); Current (A); Voltage (V); Temperature (°C)	IEC 60891; IEC 61215	M21	Range: Irradiance: up to 1000 W/m ² ; Voltage: up to 200 V; Current: up to 100 A; Temperature: 25-60 °C. Uncertainty: Temp. Coeff for Current (Alpha): 0.016%/°C; Temp. Coefficient for Voltage: (Beta) (cell): 0.011%/°C; (Beta) (module): 0.024%/°C; Temp. Coefficient for Power: (Delta) (cell): 0.020%/°C; (Delta) (module): 0.029%/°C.
SR - Spectral response & determination of mismatch factor – Indoor.	Photovoltaic device (cell or module) Single junction.	Spectral Responsivity (A/W)	IEC 60904-8; IEC 60904-3; IEC 60904-7	M04	Range: Wavelength 350-1100nm Uncertainty: Spectral Responsivity: 2.34%; Mismatch Factor: 1.02 %
SR - Spectral response & determination of mismatch factor – Indoor.	Photovoltaic device (cell or module) Single or Multi-junction.	Spectral Responsivity (A/W)	IEC 60904-8; IEC 60904-3; IEC 60904-7; ASTM E 2236-05; ASTM G173-03e1	M42; M50	Range: Wavelength 300-1750nm. Uncertainty: Spectral Responsivity 2.66%; Mismatch Factor: 0.30%.
PPhC – Primary pyrheliometer calibration - Outdoor	Pyrheliometer	Irradiance (W/m ²); Voltage (mV)	ISO-9059	M47	Range: Irradiance : 700 – 1200 W/m ² . Uncertainty: 0.42% (Depends on the square root of the sum of the squares of sample performances over multiple days and the remainder of measurement uncertainties).

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Calibration field	Calibration objects	Quantity, property	Reference to standardised procedure	Internal calibration procedure reference	Calibration and Measurement Capability (CMC)
PPnC - Primary pyranometer calibration - Outdoor	Pyranometer	Irradiance (W/m ²); Voltage (mV)	ISO-9846	M25	Range: Irradiance: 700 – 1200 W/m ² . Uncertainty: 0.55% (Depends on the square root of the sum of the squares of sample performances over multiple days and the remainder of measurement uncertainties).
SPnC - Secondary pyranometer calibration - Outdoor	Pyranometer	Irradiance (W/m ²); Voltage (mV)	ISO-9847	M26	Range: Irradiance: 700 – 1200 W/m ² . Uncertainty: 0.65% (Depends on the square root of the sum of the squares of sample performances over multiple days and the remainder of measurement uncertainties).
PS - Measurement of PV current-voltage characteristics – Indoor.	Photovoltaic device (cell)	Irradiance (W/m ²); Current (A); Voltage (V)	IEC 60904-1	M05; M06; M41	Range: Irradiance: up to 250KW/m ² ; Voltage up to 200 V; Current: up to 100 A Uncertainty: Short Circuit Current: 0.72%; Open Circuit Voltage: 0.12%; Maximum Power Point: 1.4%; Efficiency: 1.4% (depends on the square root of the sum of the squares of Maximum Power Point and the dimension determination calculated for each device).
PS - Measurement of PV current-voltage characteristics – Indoor.	Photovoltaic device (module)	Irradiance (W/m ²); Current (A); Voltage (V)	IEC 60904-1	M05; M06	Range: Irradiance: up to 1200W/m ² ; Voltage up to 200 V; Current: up to 100 A Uncertainty: Short Circuit Current: 1.7%; Open Circuit Voltage: 0.30%; Maximum Power Point: 1.9%; Efficiency: 1.9% (depends on the square root of the sum of the squares of Maximum Power Point and the dimension determination calculated for each device).

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Calibration field	Calibration objects	Quantity, property	Reference to standardised procedure	Internal calibration procedure reference	Calibration and Measurement Capability (CMC)
Calibration of primary PV reference cells – Indoor.	PV reference cell	Spectral irradiance ($W/(\mu m^2)$); Current (A)	IEC 60904-4;	M44	Range: Spectral irradiance 350 nm – 1200 nm. Uncertainty: Calibration value: 2.44%.
Calibration of primary PV reference cells – Outdoor.	PV reference cell	Irradiance (W/m^2); Current (A); Spectral irradiance ($W/(\mu m^2)$); (optional)	Based on ISO-9846; IEC 60904-4; ASTM E1039-99 (withdrawn); ASTM E1125-05	M45	Range: Irradiance: 800 –1200 W/m^2 ; Spectral irradiance 350 nm –2500 nm (optional). Uncertainty: 0.64% (Depends on the square root of the sum of the squares of the sample performances over multiple days and the remainder of measurement uncertainties).
PS - Measurement of PV current-voltage characteristics – Outdoor.	Photovoltaic device (cell)	Irradiance (W/m^2); Current (A); Voltage (V)	IEC 60904-1	M46	Range: Irradiance: 800-1200 W/m^2 ; Voltage up to 200 V; Current: up to 40 A. Uncertainty: Short Circuit Current: 0.74%; Open Circuit Voltage: 0.76%; Maximum Power: 1.3%. Efficiency: 1.3% (depends on the square root of the sum of the squares of Maximum Power Point and the dimension determination calculated for each device).
PS - Measurement of PV current-voltage characteristics – Outdoor.	Photovoltaic device (module)	Irradiance (W/m^2); Current (A); Voltage (V)	IEC 60904-1	M46	Range: Irradiance: 800-1200 W/m^2 ; Voltage up to 200 V; Current: up to 40 A. Uncertainty: Short Circuit Current: 0.76%; Open Circuit Voltage: 1.4%; Maximum Power: 1.7%; Efficiency: 1.7% (depends on the square root of the sum of the squares of Maximum Power Point and the dimension determination calculated for each device).

The Centre is recognised competent for adopting, adapting and implementing any standardised method in the accredited field of calibration

ANNEX: ADDITIONAL INFORMATION

Calibration field	Additional Information 1: principle of the method	Additional Information 2: limitations	Additional Information 3: calibration reference	Additional Information 4: references
TCO - Determination of the temperature coefficients of current and voltage of PV devices	Determination of the Temperature Coefficients of current (alpha) and voltage (beta) of PV devices performed at temperatures between 25°C and 60°C	Maximum specimen dimensions for indoor characterisation = 1.85m x 1.5m; Maximum Temperature 65°C;	PV reference cells; current and voltage reference standards (multifunction calibrator); temperature standard (PT100)	See:UC21
SR - Spectral response & determination of mismatch factor	Determination of the relative spectral responsivity of linear PV devices. Determination of the MMF caused by the interaction of the mismatch between test & ref. device spectral responsivity and test & ref. spectrum	Maximum specimen dimensions = up to diameter of 2 m; Not multi-junction material	PV reference cells; monochromatic interference filters	See:UC04
SR - Spectral response & determination of mismatch factor	Determination of the relative spectral responsivity of linear PV devices. Determination of the MMF caused by the interaction of the mismatch between test & ref. device spectral responsivity and test & ref. spectrum	Maximum specimen dimensions = up to 0.3m x 0.3m;	PV reference cells; monochromatic interference filters	See:UC42
PPhC – Primary pyr heliometer calibration	Determination of responsivity factor		Absolute cavity radiometer	See : UC47
PPnC - Primary pyranometer calibration	Determination of responsivity factor using the continuous sun-and-shade method (CoSSM)		Absolute cavity radiometer; primary pyranometer	See:UC25
SPnC - Secondary pyranometer calibration	Determination of responsivity factor using sun pointing mount method for normal-incidence calibration		Primary pyranometer	See:UC26.
PS - Measurement of PV current-voltage characteristics	Measurement procedures for current-voltage characteristics of PV devices (cell) in simulated sunlight	Maximum specimen dimensions for indoor characterisation = up to 30cm x 30cm;	PV reference cells; current and voltage reference standards (multifunction calibrator)	See: UC06; UC05; UC41; M51.
PS - Measurement of PV current-voltage characteristics	Measurement procedures for current-voltage characteristics of PV devices (module) in simulated sunlight	Maximum specimen dimensions for indoor characterisation = up to diameter of 2m;	PV reference cells; current and voltage reference standards (multifunction calibrator)	See: UC06;UC05; M51.
Calibration of primary PV reference cells	Determination of the calibration value using absolute spectral irradiance of solar simulator		Standard lamp ; Spectroradiometer	See M44
Calibration of primary PV reference cells	Determination of the calibration value using global natural sunlight and sun tracking		Absolute cavity radiometer; Primary pyranometer; Standard lamp and spectroradiometer (optional)	See M45

ANNEX: ADDITIONAL INFORMATION

Calibration field	Additional Information 1: principle of the method	Additional Information 2: limitations	Additional Information 3: calibration reference	Additional Information 4: references
PS - Measurement of PV current-voltage characteristics	Measurement procedures for current-voltage characteristics of PV devices (cell) in natural sunlight	Maximum specimen dimensions for outdoor characterisation = 22cm x 22cm;	PV reference cells; current and voltage reference standards (multifunction calibrator); standard lamp and spectroradiometer	See: <i>UC46;M51</i>
PS - Measurement of PV current-voltage characteristics	Measurement procedures for current-voltage characteristics of PV devices (module) in natural sunlight	Maximum specimen dimensions for outdoor characterisation = 2.0m x 2.0m;	PV reference cells; current and voltage reference standards (multifunction calibrator); standard lamp and spectroradiometer	See: <i>UC46;M51</i>

Il Direttore di Dipartimento