CERTIFICATE OF ACCREDITATION

ANSI-ASQ National Accreditation Board
500 Montgomery Street, Suite 625, Alexandria, VA 22314, 877-344-3044

This is to certify that
Schatz Energy Research Center
Humboldt State University
1 Harpst Street
Arcata, CA 95521

has been assessed by ANAB
and meets the requirements of international standard

ISO/IEC 17025:2005

while demonstrating technical competence in the field of

TESTING

Refer to the accompanying Scope of Accreditation for information regarding the types of tests to which this accreditation applies.

AT-2022
Certificate Number

ANAB Approval

Certificate Valid: 02/02/2018-01/05/2020
Version No. 003 Issued: 02/02/2018

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).

ANSI-ASQ National Accreditation Board

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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TESTING

Valid to: **January 5, 2020** Certificate Number: **AT-2022**

Photometry

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Light output test (a) Luminous flux (lm) (b) Correlated colour temperature (CCT) (K) (c) Colour rendering index (CRI)	IEC/TS 62257-9-5	Stand-alone renewable energy products	1 m integrating sphere CCD spectrometer
Lumen maintenance test (according to Clause J.4 or Clause J.6) (a) Lumen maintenance at 2000 h (b) Lumen maintenance at 1000 h (c) Lumen maintenance at 500 h	IEC/TS 62257-9-5	Stand-alone renewable energy products	Photometer box constructed per IEC 62257-9-5 Annex Y Illuminance meter For the alternate method using IESNA LM-80-08 data (Clause J.6): fine wire thermocouple thermometer
Light distribution test (a) Vertical and horizontal full width half maximum (FWHM) angles (°) (b) Usable area with illuminance greater than a specified threshold (m^2) (c) Work surface illuminance (lux)	IEC/TS 62257-9-5	Stand-alone renewable energy products	Light distribution grid testing surface Angular positioning apparatus Illuminance meter

Electrical

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Visual screening, except dimension and mass	IEC/TS 62257-9-5	Stand-alone renewable energy products	Camera Functionality Check
Battery test (a) Battery capacity (mAh) (b) Battery round-trip energy efficiency (%)	IEC/TS 62257-9-5	Stand-alone renewable energy product batteries	Cadex C8000 and C7400 battery analyzers
Full-battery run time test (a) Full-battery run time, to L_{70} (h) (b) Typical battery discharge voltage and current (V), (mA) (c) Average power over the full-battery run time (W) (d) Energy removed from the battery over the L70 run time (Wh) (e) Energy removed from the battery until the DUT reaches a low-voltage disconnect or other stopping criterion (Wh) (f) Deep discharge voltage (V) (g) Presence of active or passive deep discharge protection (yes/no)	IEC/TS 62257-9-5	Stand-alone renewable energy products	Constant-geometry dark cabinet Voltage data logger Current transducer 0-2 A
Grid charge test (a) Grid-charge energy (Wh)	IEC/TS 62257-9-5	Stand-alone renewable energy products with grid charging	Current and voltage data acquisition system
Electromechanical charge test (a) Electromechanical charger power (W) (b) Electromechanical charger energy (Wh)	IEC/TS 62257-9-5	Stand-alone renewable energy products with mechanical charging	Stopwatch Current and voltage data acquisition system Data-logging digital multimeter

Electrical

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Outdoor photovoltaic module I-V characteristics test (a) Short-circuit current (A), open-circuit voltage (V), maximum power point power (W), maximum power point current (A), maximum power point voltage (V) at STC (standard test conditions) and TMOT (typical module operating temperature) (b) Relative temperature coefficient of open-circuit voltage (%/°C) (c) STC I-V curve dataset (V), (A)	IEC/TS 62257-9-5	Stand-alone renewable energy products with solar PV module	Indoor tests: Newport 94083A continuous solar simulator PV reference cell for testing Si modules Keithley 2400 source-measure instrument Thermocouple thermometer Outdoor tests: Outdoor I-V curve tracer (rheostat-based) Silicon pyranometer Eppley PSP pyranometer Thermocouple thermometer
Solar charge test (a) Solar operation efficiency (η_{sol-op}) (%) (b) Battery charging circuit efficiency (η_{bcc}) (%) (c) Average charging voltage (V) (d) Solar charging system characteristics (qualitative) (e) Energy allocation ratio (%)	IEC/TS 62257-9-5	Stand-alone renewable energy products	Surface-mounted thermocouple(s) Thermocouple thermometer DC power supply, with programmable capability Variable power resistors Voltage/current/temp data acquisition system

Electrical

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Charge controller behaviour test (a) Deep discharge protection voltage (V) (b) Overcharge protection voltage (V) (c) Passive deep discharge protection battery voltage at 24 h (V/cell) (d) Passive overcharge protection continuous charging current (A) (e) Standby loss current (A) (f) Time before switching to low-power mode (h) (g) Presence of active or passive deep discharge and overcharge protection (yes/no)	IEC/TS 62257-9-5	Stand-alone renewable energy products	Surface-mounted thermocouple(s) Thermocouple thermometer DC power supply, with programmable capability Variable power resistors Voltage/current data acquisition system Voltage data logger Current transducer 0-2 A Data-logging digital multimeter
Physical and water ingress protection test	IEC/TS 62257-9-5	Stand-alone renewable energy products	Camera Rigid probes Controlled water source
Mechanical durability test (a) Drop test (b) Switch and connector test (c) Gooseneck test (d) Strain relief test	IEC/TS 62257-9-5	Stand-alone renewable energy products	Camera Stopwatch Tape measure or ruler 2 kg weight
Battery durability test (a) Capacity loss from storage (%)	IEC/TS 62257-9-5	Stand-alone renewable energy product batteries	Lab oven or custom-built temperature chamber Cadex C7400/C8000 battery analyzer

Electrical

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Energy service calculations (a) The following values for full-battery, standard solar day, electromechanical and grid charging conditions: (1) Run times under advertised and example usage profiles and individual usage (h) (2) Estimated fraction of full charge for mobile devices under advertised and example usage profiles and individual usage (%) (3) Energy available to appliances (Wh) (b) Estimated solar charging time (h)	IEC/TS 62257-9-5	Stand-alone renewable energy products	
Protection tests (a) Miswiring protection test (b) Output overload protection test (c) PV overvoltage protection test	IEC/TS 62257-9-5	Stand-alone renewable energy products	DC power supply with programmable capability Digital multimeters AC power meter DC electronic load

Electrical

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Assessment of DC ports (a) Minimum and maximum port voltage (V) (b) Port voltage vs. current data set (A, V) (c) Port voltage vs. power data set (A, W) (d) Battery-to-port efficiency vs. current data set (%, A) (e) Battery-to-port efficiency vs. power data set (%, W) (f) Shared and individual port resistances (Ω) (g) Built-in appliance power consumption (W) (h) Appliance functionality (yes/no) (i) Peak overshoot voltage (V) (j) Minimum undershoot voltage (V) (k) Undershoot time (ms) (l) Maximum port power (W) (m) Pass-fail tests: functionality and truth in advertising (n) Data line resistance (Ω) (o) Data line (D- and D+) voltage (V)	IEC/TS 62257-9-5	Stand-alone renewable energy products	DC power supply with programmable capability Digital multimeters AC power meter Pulse-capable DC electronic load Digital storage oscilloscope (2 channel)

Electrical

Specific Tests and/or Properties Measured	Specification, Standard, Method, or Test Technique	Items, Materials or Product Tested	Key Equipment or Technology
Appliance tests (a) Appliance operating voltage, current, and power consumption (V, A, W) (b) Slope of current vs. voltage (A/V) (c) Charging efficiency (%) (d) Estimated full-battery run time (h) (e) Appliance functionality/voltage compatibility (yes/no) (f) Appliance full-battery run time (h) (g) Average power over the run time (W) (h) Energy removed from the battery over the run time (Wh) (i) Active deep discharge protection voltage (V) (j) Passive deep discharge protection voltage (V)	IEC/TS 62257-9-5	Stand-alone renewable energy products	DC power supply with programmable capability Digital mulitmeters Cadex C7400/C8000 battery analyzer

Note:

1. This scope is formatted as part of a single document including Certificate of Accreditation No. AT-2022.

Vice President