

**Industrial Laboratory of Low-Emission and Renewable Energy Sources
Kielce University of Technology, Poland
Al. Tysiaclecia P.P. 7, 25-314 Kielce, Poland**

Mobile Laboratory for the audit of photovoltaic installations, including simulation of light, electroluminescence, thermovision, etc. (mobile container PV laboratory)

Order description:

The object of estimating the value of the contract is a mobile laboratory for the inspection of PV modules in the field, hereinafter referred to as the Mobile Laboratory.

The Mobile Laboratory should be mounted on a trailer approved for traffic on public roads, with a total weight (including loading) not exceeding 1500 kg, equipped with an overrun brake. The ordering party will register the trailer.

The functionality of the Mobile Laboratory relates to the performance of tests directly at the destination of PV modules and takes into account:

1. Measurements of the power and current-voltage characteristics of PV modules, allowing for the verification of data indicated on the rating plate and catalog card,
2. Infrared measurements to identify electrical damage of PV modules,
3. Electroluminescence measurements to identify damage to the crystal structure of PV modules.

The conducted tests will allow for an objective diagnosis of modules installed in the field, documented with generated reports showing the problems related to the quality of photovoltaic modules.

Technical specification:

<i>Description, technical parameters, ranges, possibilities</i>	<i>Minimum requirements of the customer</i>
Sun Simulator for PV modules and cells testing	
Certification	IEC 60904-9* or equivalent
Technology	Full spectrum long pulse LED Flasher, LED lifetime at least 1 Million Flashes
LED panel area	Min. 1050 x 2000 mm
Module types	mono-crystalline or multi-crystalline also PERC types and thin film
Spatial Non-Uniformity (%)	Class A+
Temporal Instability Short Term (%)	Class A+
Temporal Instability Long Term (%)	Class A+ or Class A++

Non uniformity	< +/- 1%*
Long term instability (LTI)	< +/- 1%*
Test duration:	100 ms – 500 ms
Total irradiance	200 – 1200 W/m ² (in 200W steps configurable)
Repeatability of Pmax	< 0,5%**
Spectrum	300 – 1200 nm, AM 1,5
Dedicated software for analysing voltage - current characteristics, including free of charge upgrade during warranty period	0-20A (automatic control based on I _{sc}), 0-250V (automatic control based on U _{oc}). Passive electrical load. Accuracy minimum +/- 0.2%.
Diode test	Configurable reverse current, voltage measurement accuracy minimum 0.2V
EL Electroluminescence tester for solar modules and cells	
Camera	4 x NIR CMOS minimum 3 Mpx
Power supply parameters	250 V / 12 A
Resolution	30 Mpx / 300µm/px
Image acquisition time	not more than 20 s
Exposure time	4 – 10 s per snap;
Dedicated EL software for analysis, including free of charge upgrade during warranty period	Yes
Thermovision tester for solar modules and cells	
Camera	IR camera with live image acquisition (various color schemes)
Resolution	at least 320 x 240 px
Temperature range:	from - 20°C to 250°C
Dedicated software for thermal analysis, including free of charge upgrade during warranty period	Yes
Other requirements	
Power	The laboratory should be powered from a single-phase external network (200-240 V, 50 Hz) and from an external generator 3,0-5 kW supplied with the mobile laboratory, securing continuous operation for min. 4 hours, powered by liquid fuel (petrol)
Air conditioning	Temperature maintenance 25 ° C / STC /
On-board computer for device management, measurement data	64-bit operating system computer with BitLocker Device Encryption, Enterprise State Roaming,

acquisition and report generation together with suitable software¹.

¹Software with free update during the warranty period.

Active Directory, and Azure Active Directory support, allowing to work remotely via RDP.

The processor introduced to the market no later than the third quarter of 2019, achieving a score of not less than 10,200 points in the 3D Mark 06 CPU test, and score not less than 6,200 in the Cinebench R10 Single 32b test, and score not less than 160 in the Cinebench R15 CPU Single 64b test. Architecture of 64-bit processor / processors with not less than 4 cores and 8 threads, base frequency of at least 2.4 GHz, supporting instructions, at least SSE4.1, MMX, AES, FMA3.

Graphics card on the PCI slot: no less than 4GB RAM, no less than 2 HDMI or DVI or DisplayPort outputs, the possibility of programming in the CUDA architecture.

RAM at least 16 GB not older than DDR4, 2 x SSD at least 470GB in MLC or SLC technology, working in RAID 1 mode.

Monitor min. 24 inches with HDMI or DisplayPort connector, matrix response time: no more than 12ms, matrix technology: TFT or PVA or IPS, matrix type: LED, FULL HD resolution.

USB wired Keyboard in US layout, membrane technology with scissor mechanism for each button, button travel not less than 2mm and not more than 3.5mm, with:

- track point
- or
- remote optical mouse with at least one roller, the ability to scroll the screen vertically and horizontally and not less than two additional programmable buttons, signal source for the sensor: laser.

Laser printer for automatic two-sided colour printing, paper size min. A4 and resolution min. 300x300 dpi, with the possibility of wireless printing.

Software for the calculation, presentation and reporting of measurement results and their analysis.

Software with a perpetual license, free upgrade during the warranty period	Integrated graphical user interface compatible with the on-board computer system, transfer using the standard, at least USB 3.0.
Barcode reader	For identification of modules, operating in wireless technology.
Dimension of the trailer containing the mobile laboratory (including drawbar): [width x height x length + weight]	(2060 x 3070 x 4500) mm, with an accuracy of +/- 5%; total weight (loaded) not more than 1500 kg.
Training*	Minimum 2 days of training (min. 16 hours) for 3 participants

**/ certificate required*

***/calibration module required*

Additional requirements that are an integral part of the contract:

1. The delivery of the complete mobile laboratory requires a commission acceptance at the Ordering Party's seat.
2. Interface in English; instruction in English.
3. Order completion date: maximum 90 days.
4. Training in the operation of the Mobile Laboratory for 3 people, completed with a confirmation in the form of a Certificate.
5. The contractor provides a guarantee for all elements of the mobile laboratory for a period of at least 2 years, counted from the commission acceptance of the complete Mobile Laboratory.
6. Warranty service and repairs, including replacement of parts, will be performed free of charge, except for consumables that result from their natural wear.
7. During the warranty period, the software upgrade will be free of charge.
8. The repair time cannot be longer than 21 days from the receipt of the notification.
9. In case of necessity of repair outside the seat of the Ordering Party, the Contractor shall cover the costs of transport both ways including suitable insurance.
10. The contractor will carry out at least one service inspection of the device at the end of each year of the warranty period.

