Testing and Certification of Solar PV modules and components

Recent changes and its requirements.

Mr. Hidayathulla M
Business Development Head – India
Senior Manager and - Solar PV Services
TUV Rheinland - Bangalore

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PV
Photo Voltaic

PV Module

BoS

Inverter
Lumineries
Cables
Battery
Charge controller
Water Pump
Etc

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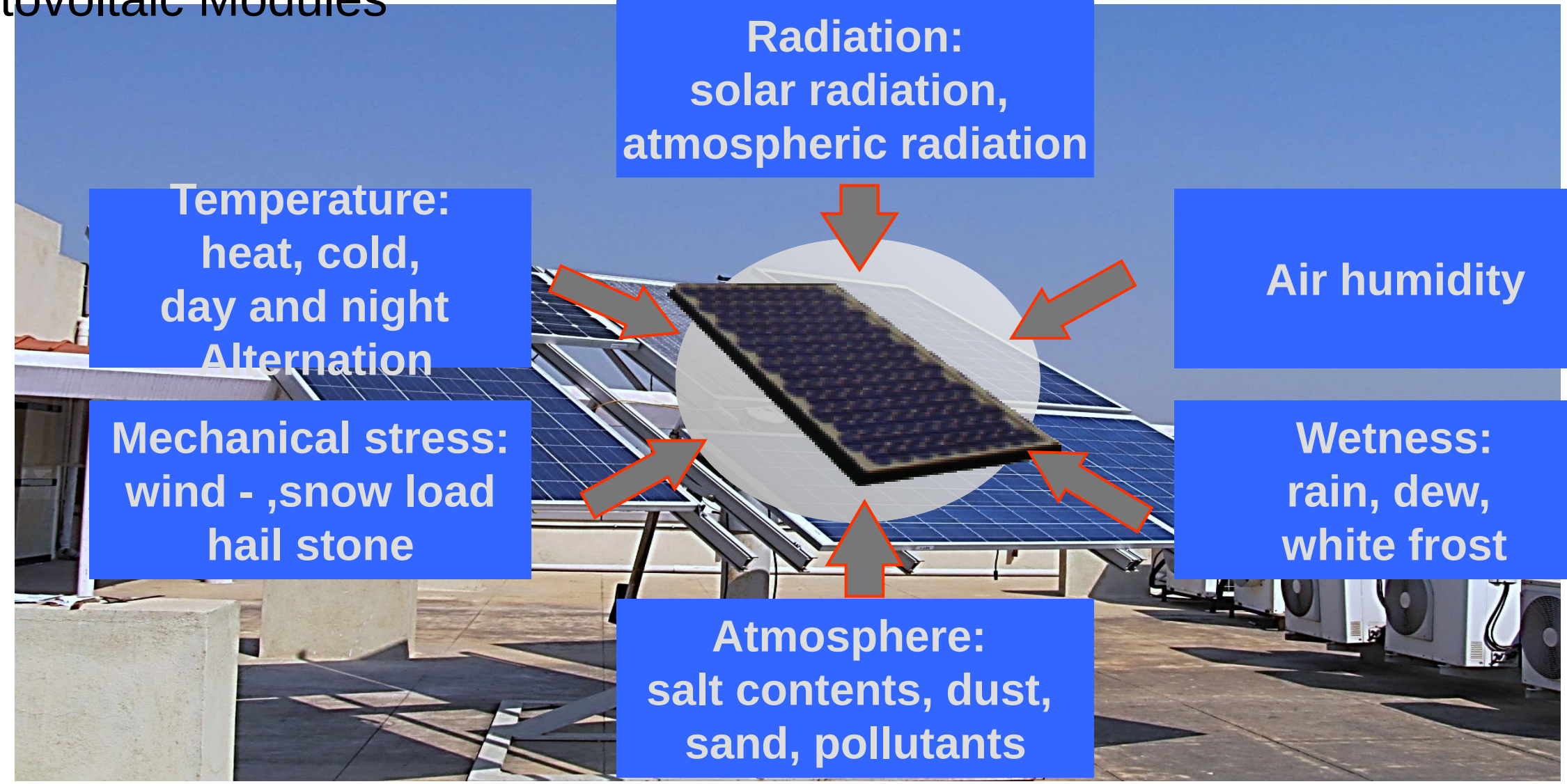
Environmental Influences During Long-term Operation of Photovoltaic Modules



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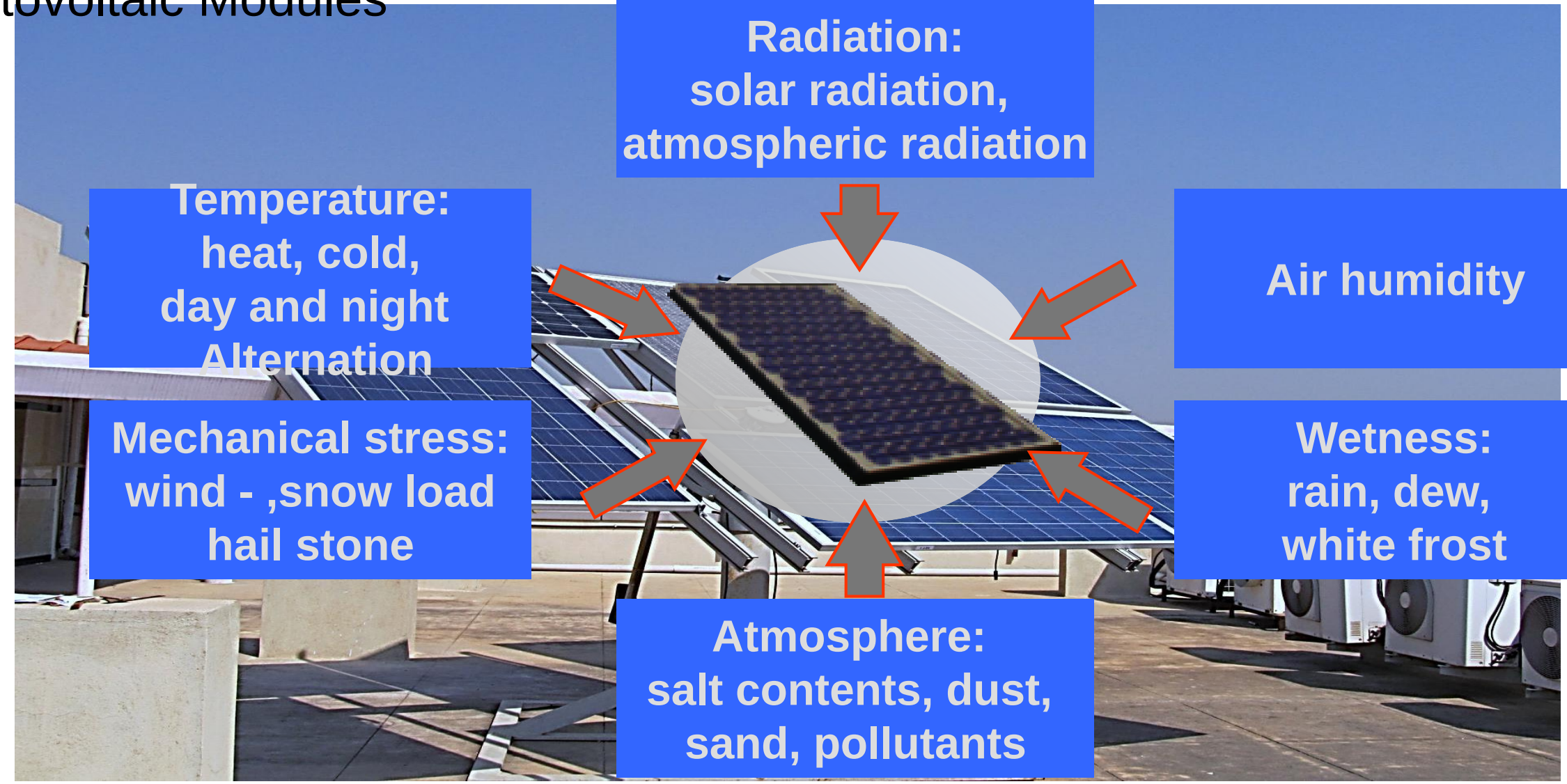
Environmental Influences During Long-term Operation of Photovoltaic Modules



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Testing of PV Products

Test Specifications
Test method
Testing Equipment
Detail Procedure
Product Construction
Etc

(Document)

STANDARD

- *Terrestrial photovoltaic (PV) modules - Design qualification and type approval – IEC 61215*
- Photovoltaic systems - Power conditioners - Procedure for measuring efficiency - IEC 61683:1999

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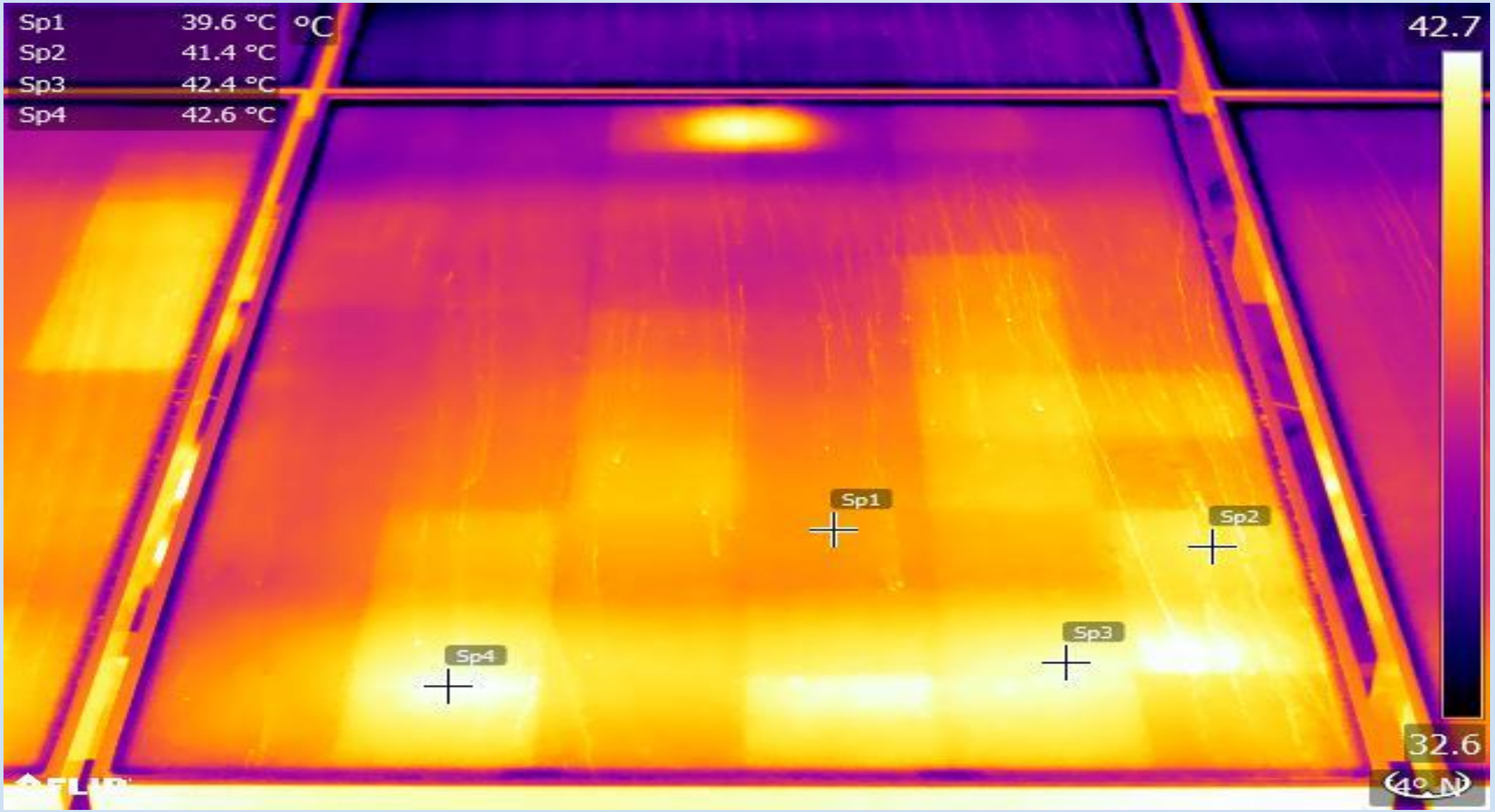
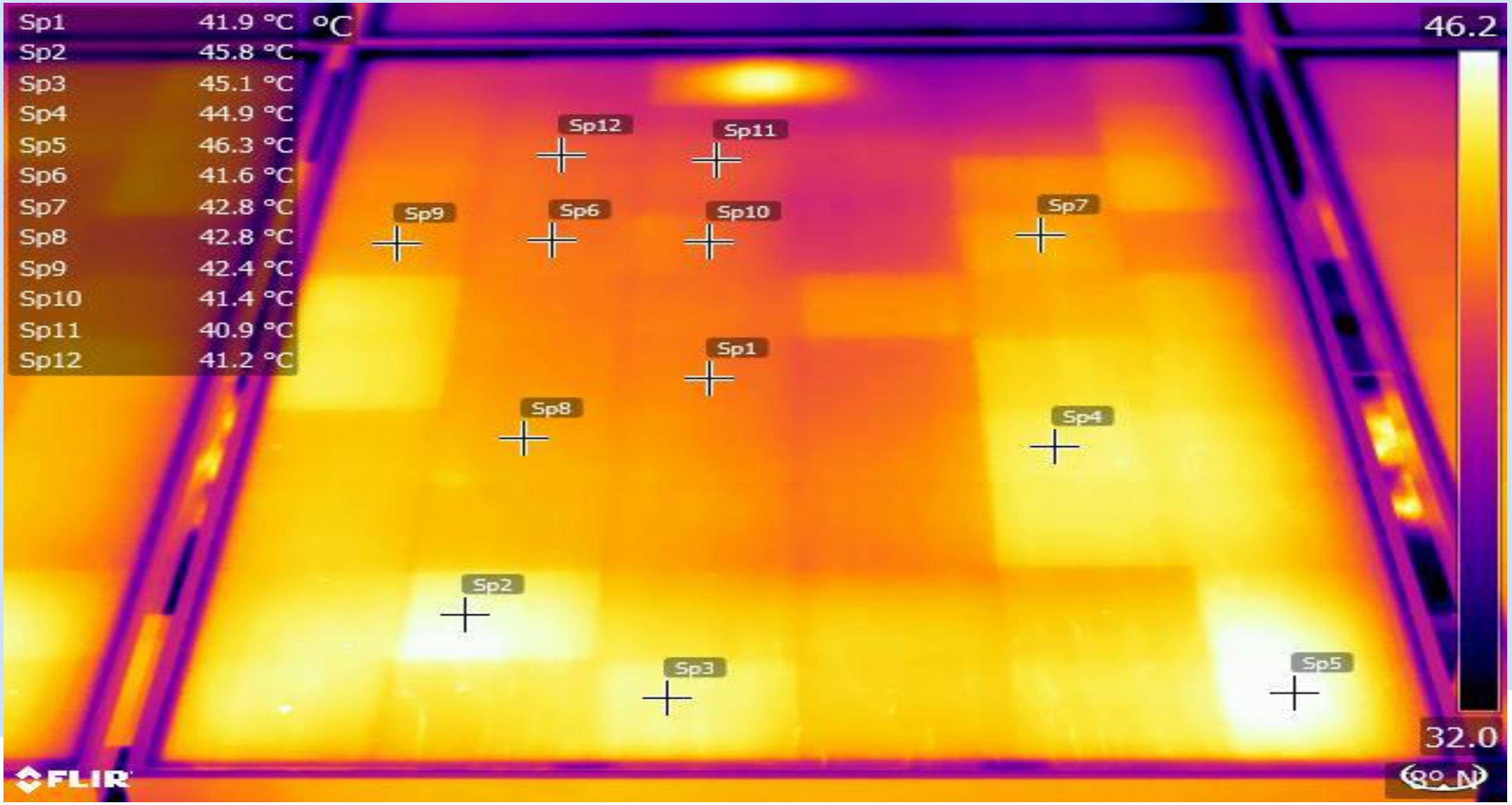

Sp1 39.6 °C
Sp2 41.4 °C
Sp3 42.4 °C
Sp4 42.6 °C
°C
42.7
32.6
Sp1
Sp2
Sp3
Sp4



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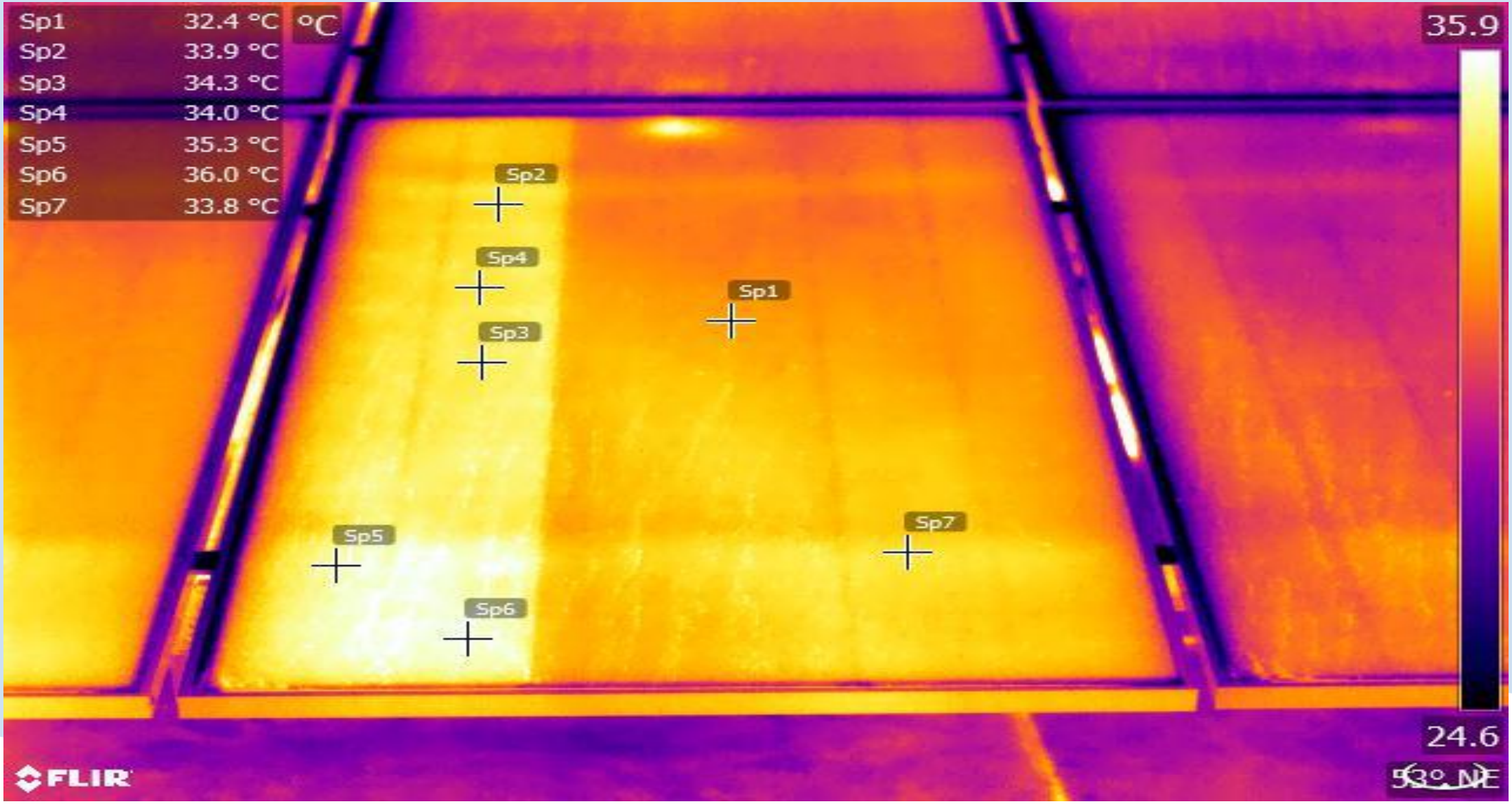

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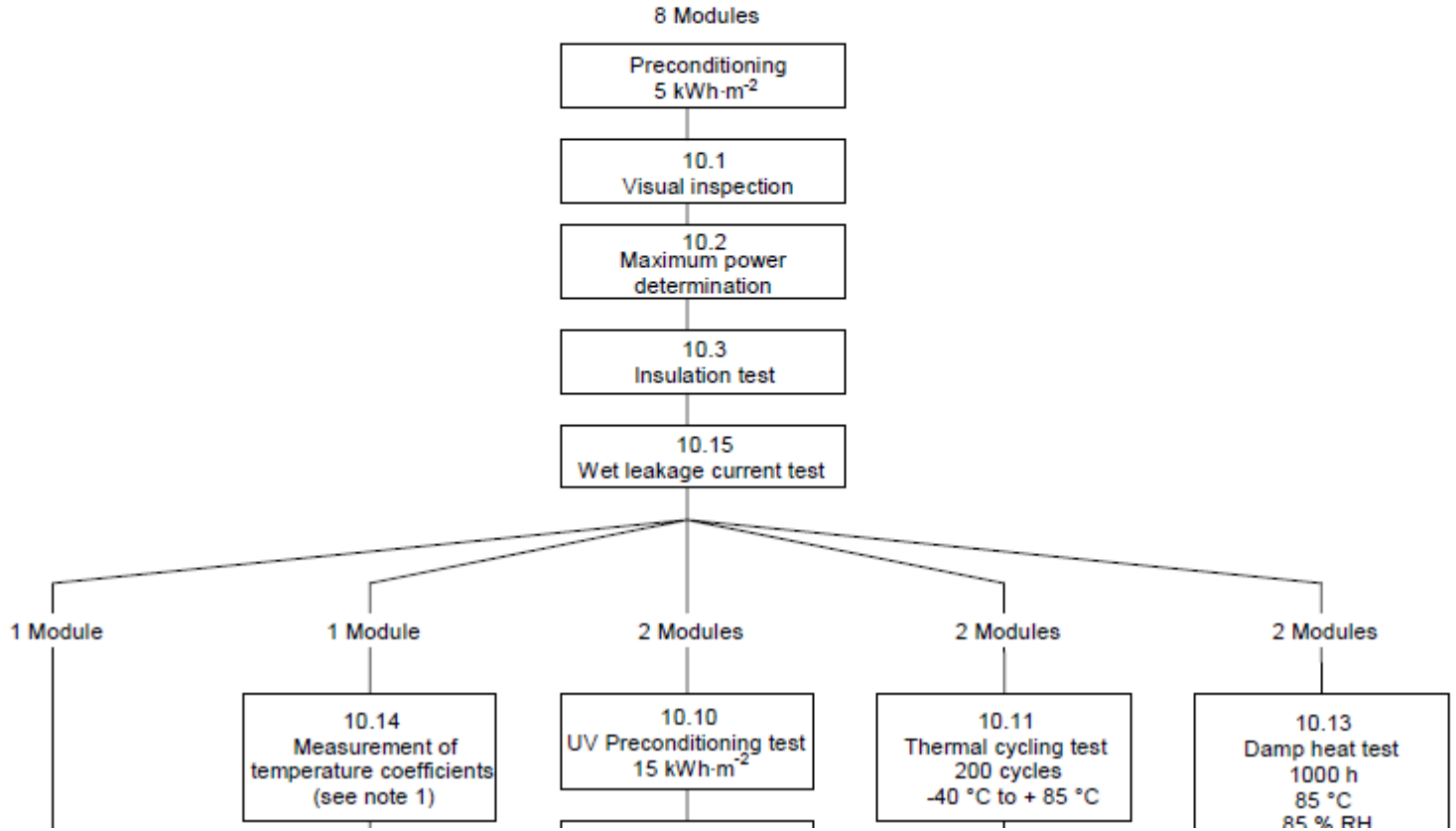

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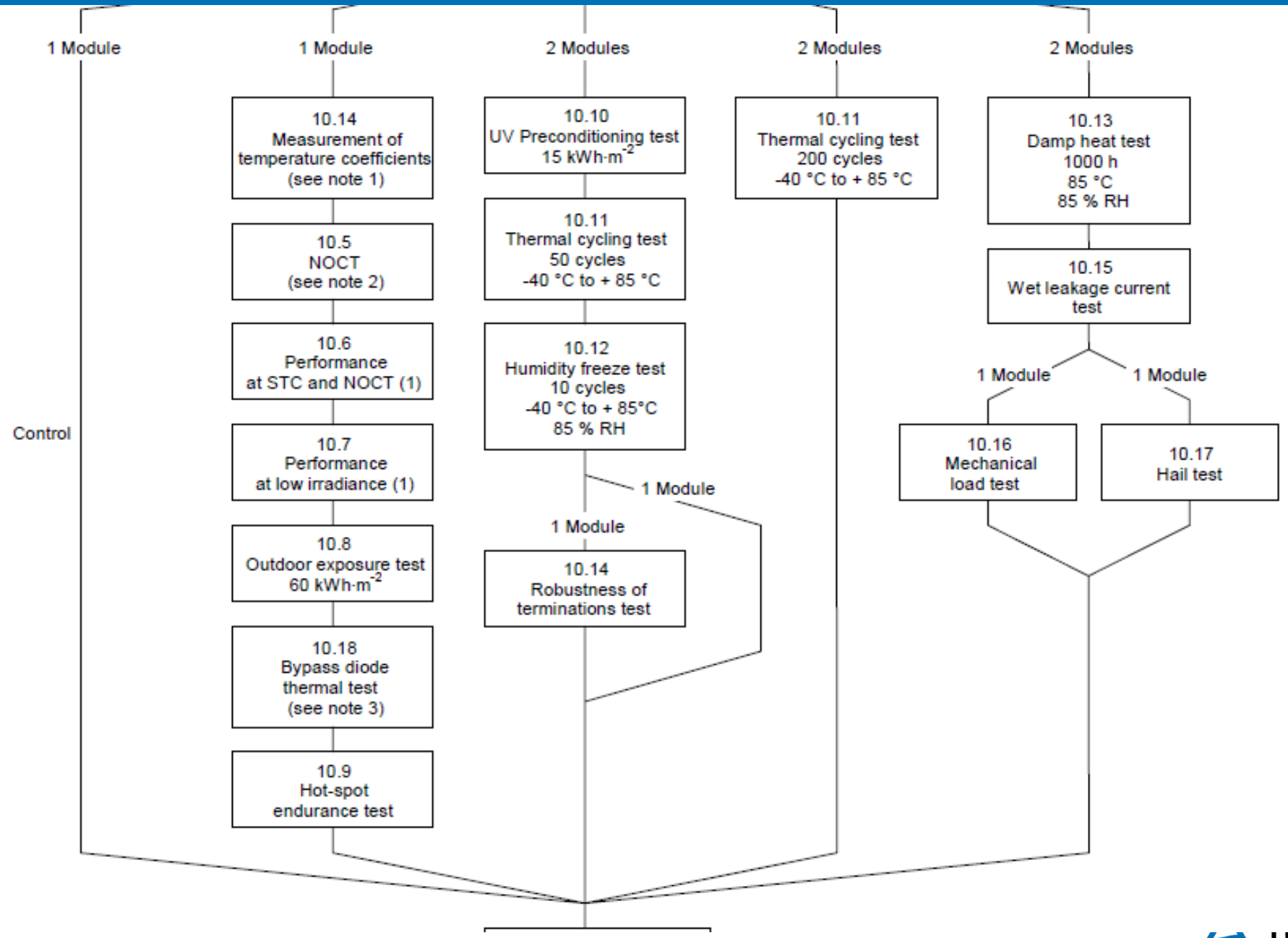

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Test	Title	Test conditions
10.1	Visual inspection	See detailed inspection list in 10.1.2
10.2	Maximum power determination	See IEC 60904-1
10.3	Insulation test	Dielectric withstand at 1 000 V d.c. + twice the maximum systems voltage for 1 min. For modules with an area of less than 0,1 m^2 the insulation resistance shall be not less than 400 MΩ. For modules with an area larger than 0,1 m^2, the measured insulation resistance times the area of the module shall be not less than 40 MΩ·m^2 measured at 500 V or maximum systems voltage, whichever is greater
10.4	Measurement of temperature coefficients (see note 1)	See details in 10.4 See IEC 60904-10 for guidance.
10.5	Measurement of NOCT (see note 1)	Total solar irradiance: 800 W·m^{-2} Ambient temperature: 20 °C Wind speed: 1 m·s^{-1}
10.6	Performance at STC and NOCT (see note 1)	Cell temperature: 25 °C and NOCT

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10.10	UV preconditioning	15 kWh·m^{-2} total UV irradiation in the wavelength range from 280 nm to 385 nm with 5 kWh·m^{-2} UV irradiation in the wavelength range from 280 nm to 320 nm
10.11	Thermal cycling test	50 and 200 cycles from –40 °C to + 85 °C with STC peak power current during 200 cycles
10.12	Humidity freeze test	10 cycles from + 85 °C, 85 % RH to –40 °C
10.13	Damp heat test	1 000 h at + 85 °C, 85 % RH
10.14	Robustness of termination test	As in IEC 60068-2-21
10.15	Wet leakage current test	See details in 10.15 For modules with an area of less than 0,1 m^2 the insulation resistance shall be not less than 400 MΩ. For modules with an area larger than 0,1 m^2 the measured insulation resistance times the area of the module shall be not less than 40 MΩ·m^2 to be measured at 500 V or maximum systems voltage, whichever is greater
10.16	Mechanical load test	Three cycles of 2 400 Pa uniform load, applied for 1 h to front and back surfaces in turn. Optional snow load of 5 400 Pa during last front cycle
10.17	Hail test	25 mm diameter ice ball at 23,0 m·s^{-1}, directed at 11 impact locations

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Sample Testing at Photovoltaic Laboratory

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Electrical Safety tests

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Mechanical Safety testing

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Environmental Chambers

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Outdoor Exposure

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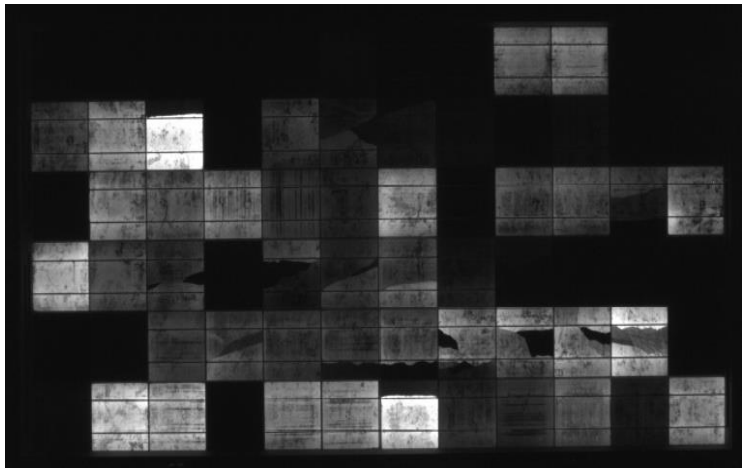

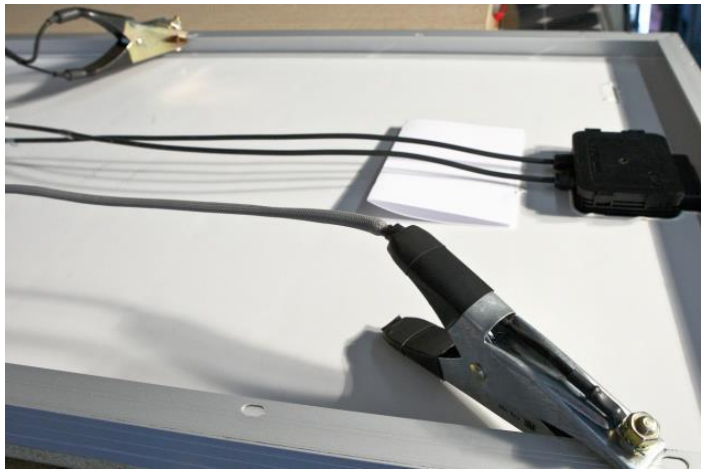

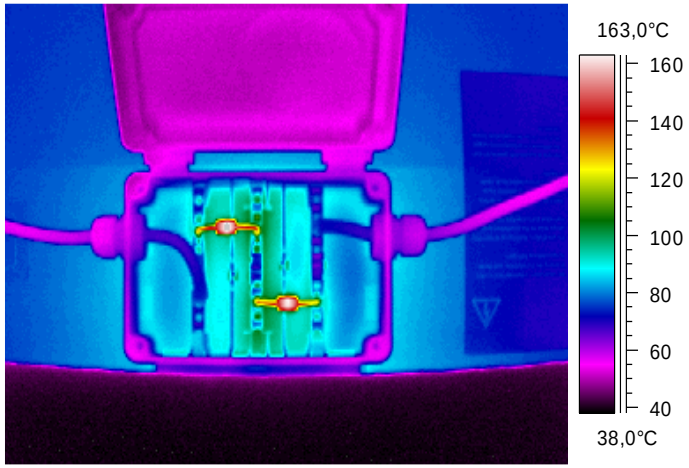

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Testing of Crystalline PV Modules
Basic requirements – Indian Market

भारतीय मानक ब्यूरो
Bureau of Indian Standards
The National Standards Body of India

Crystalline Silicon Terrestrial Photovoltaic (PV) modules - Design Qualification And Type Approval **- IS 14286**

Photovoltaic (PV) Module Safety Qualification

- Part 1 Requirements for Construction **- IS/IEC 61730 (Part 1)**
- Part 2 Requirements for Testing **- IS/IEC 61730 (Part 2)**

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Certification of Crystalline PV Modules
Basic certification – Global Market

- ***Terrestrial photovoltaic (PV) modules - Design qualification and type approval***
- - Part 1: Test requirements - **IEC 61215-1:2016**
- - Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules- **IEC 61215-1-1:2016**
- - Part 2: Test procedures - **IEC 61215-2:2016**

- ***Photovoltaic (PV) module safety qualification***
- - Part 1: Requirements for construction - **IEC 61730-1:2016**
- - Part 2: Requirements for testing - **IEC 61730-2:2016**

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Other Certification of Crystalline PV Modules

- Salt mist corrosion testing of photovoltaic (PV) modules **- IEC 61701:2011**
  - Sev 1: Indian requirement
  - Sev 6: Global requirement
- Photovoltaic (PV) modules - Test methods for the detection of potential-induced degradation**(PID**) - Part 1: Crystalline silicon - **IEC TS 62804-1:2015**
  - 85 degC, 85% Rh, 96 Hours, 3 Cycles: Indian Requirement
- Photovoltaic (PV) module performance testing and energy rating **(PAN File)** - Part 1: Irradiance and temperature performance measurements and power rating - **IEC 61853-1:2011**

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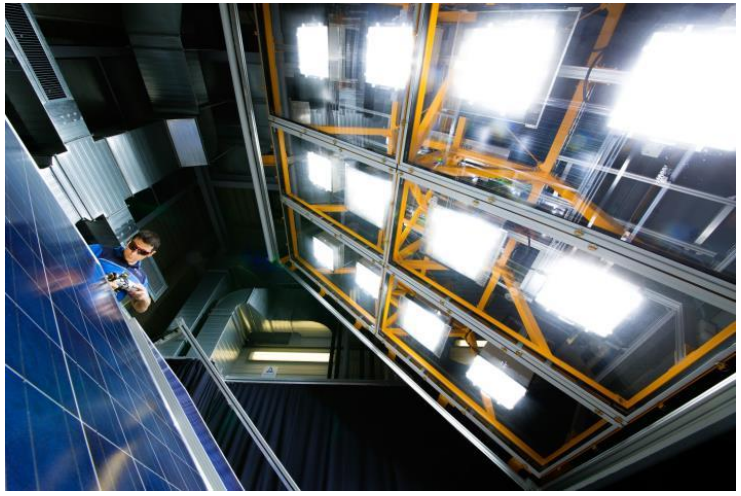
Other Certification of Crystalline PV Modules

Photovoltaic (PV) modules - Ammonia corrosion testing - **IEC 62716:2013**

Photovoltaic (PV) modules - Transportation testing - Part 1: Transportation and shipping of module package units - **IEC 62759-1:2015**

Environmental testing - Part 2-68: Tests - Test L: Dust and sand - **IEC 60068-2-68:1994**



US and Canada Market

– ANSI/UL 1703 and CAN/CSA 61730-1/-2

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Review of IEC 61215:2016 (type approval) – Changes in the Requirements

General requirements and regulations (IEC 61215-1) :

More Samples for Testing per Module Type Family

- If several power classes to be approved (within the limits of IEC/TS 62915):
- 2 modules to be taken from lower and upper end and from median of distribution
- Type label: tolerance for P**max**, I**sc**, V**oc** required
- Type label verification: For each module type label values (P**max**, I**sc**, V**oc**) to be confirmed.
- Pass criteria: Max. 5 % degradation in output power allowed per test sequence

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Review of IEC 61215:2016 (type approval) – Changes in the Requirements

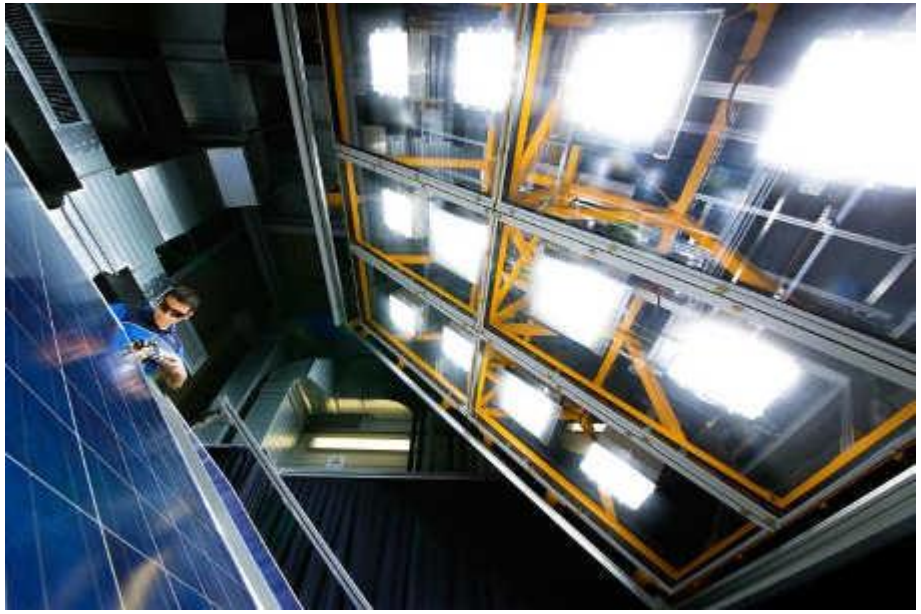
MQT 02 – Maximum power determination

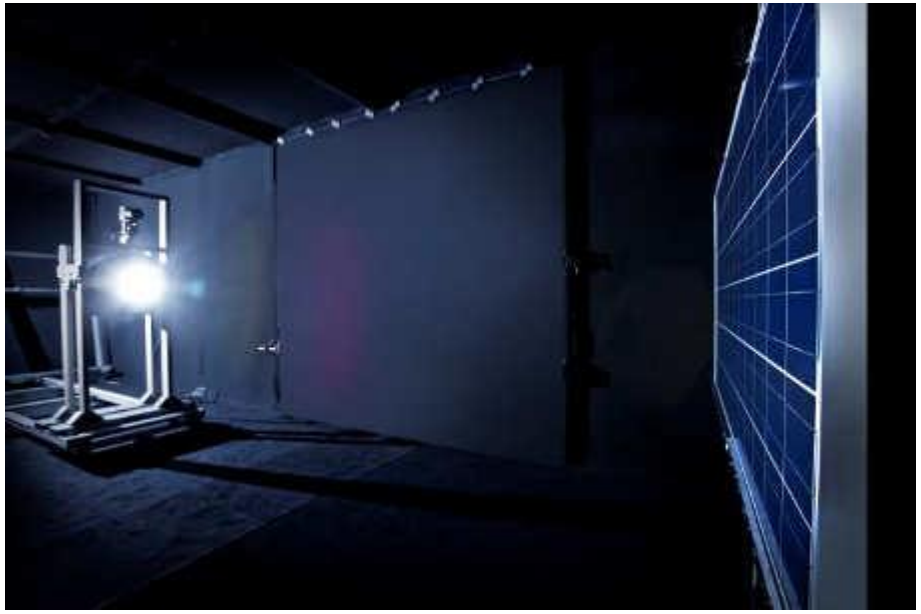
Pre-Conditioning Methods

Purpose: Determination of maximum output power of modules after stabilization and before and after environmental stress tests.

For power loss determination, reproducibility has to be considered.

Requirements for simulator and for performance measurements slightly changed





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Review of IEC 61215:2016 (type approval) – Changes in the Requirements

MQT 05 – Measurement of nominal module operating temperature (NMOT):

New value information for data sheets – **P@NMOT**

MQT 09 – Hot-spot endurance test (wafer-based technologies)

- Minor changes
- Purpose: To determine module ability to withstand hot-spot heating effects

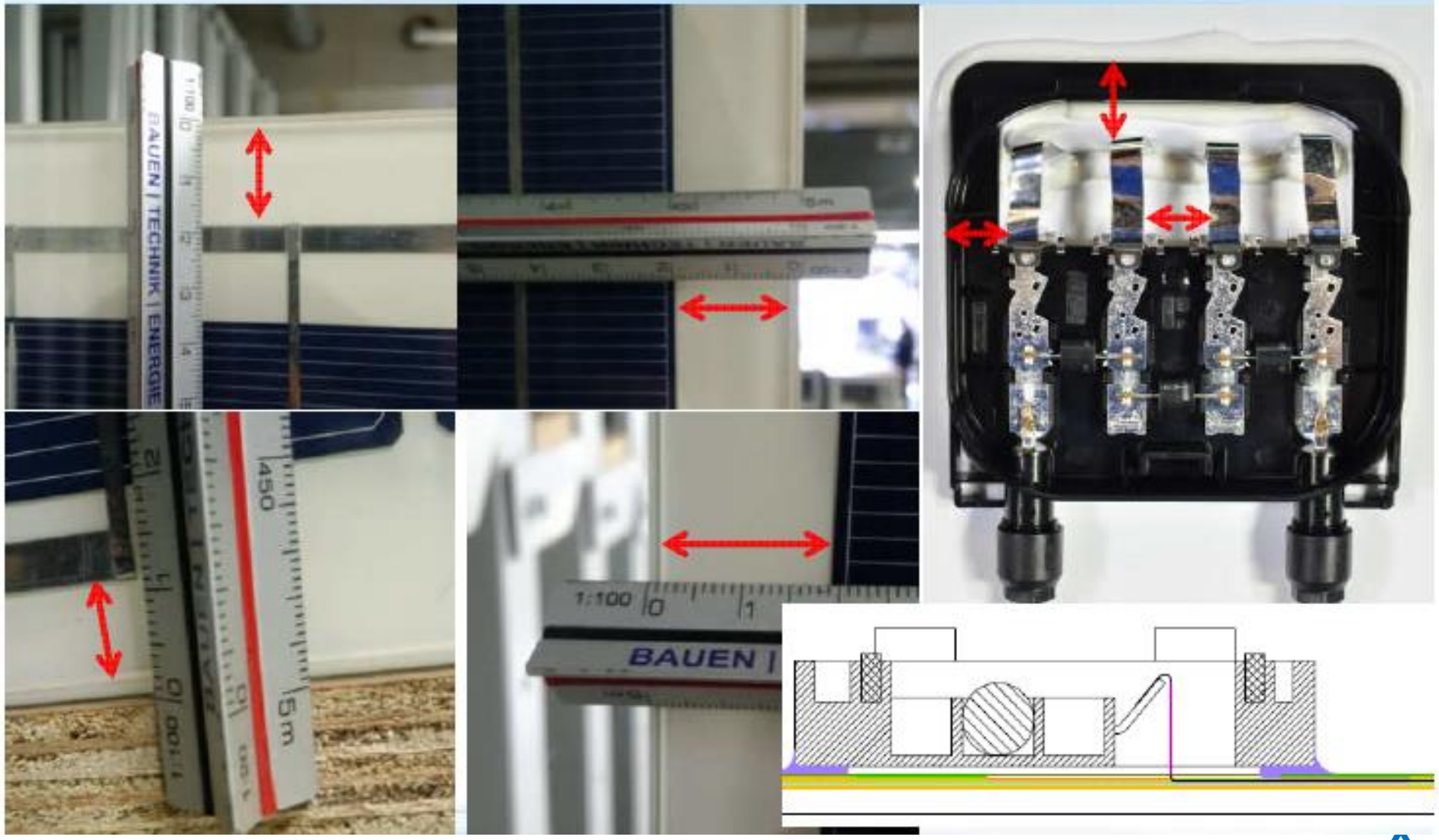
Classification of cell interconnection: case S (serial), case PS (parallel-serial), case SP (serial-parallel)

Selection of four test cells (lowest shunt resistance cell at module edge, (in addition) two lowest shunt resistance cells, highest shunt resistance cell)

MQT 10 – UV preconditioning test

Review of IEC 61730-1:2016 (safety qualification)

Creepage and clearance distances



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Key notes of 2016 version IEC standards,

IEC 61215-1, -1-1 and -2 were published in March 2016.

IEC 61215-1-2, 1-3 and 1-4 were published in December 2016.

IEC 61730-1 and -2 were published in August 2016.

North America has formed a committee for the harmonization of ANSI/UL 1703 and IEC 61730; aim: ANSI 61730.

Retesting in case of design or material changes are regulated in IEC TS 62915 (former IECEE Retesting Guideline).

Pollution Degree 1 testing acc. to IEC 61730-1 sequence B1 may enable reduced edge distances and makes Material Groups irrelevant for these.

Material Group I requires a CTI ≥ 600 from all materials that may form a creepage path surface. Material Group I may allow smaller edge distances even for higher Pollution Degrees.

Generally, new standards provide a large number of options for manufacturers in order to expose its design on the market, but require detailed design review in advance and pre-information to be supplied for test institute

Technology Based-
Specific Sub-standards

Internationally Synchronous-
E.g. IEC / UL

Clear Guidelines –
Separate Retesting standards

Raw Materials Grading-
Material Group / Pollution degree

CTI values for Polymers used

Very Robust and reliable

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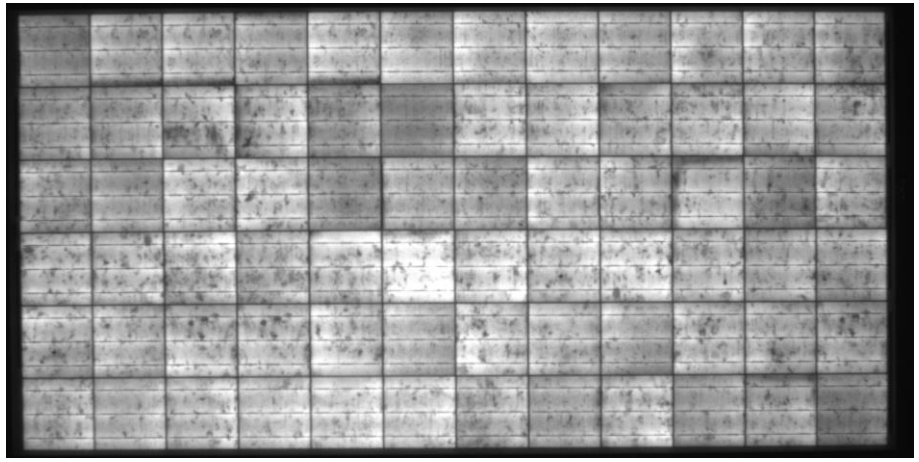
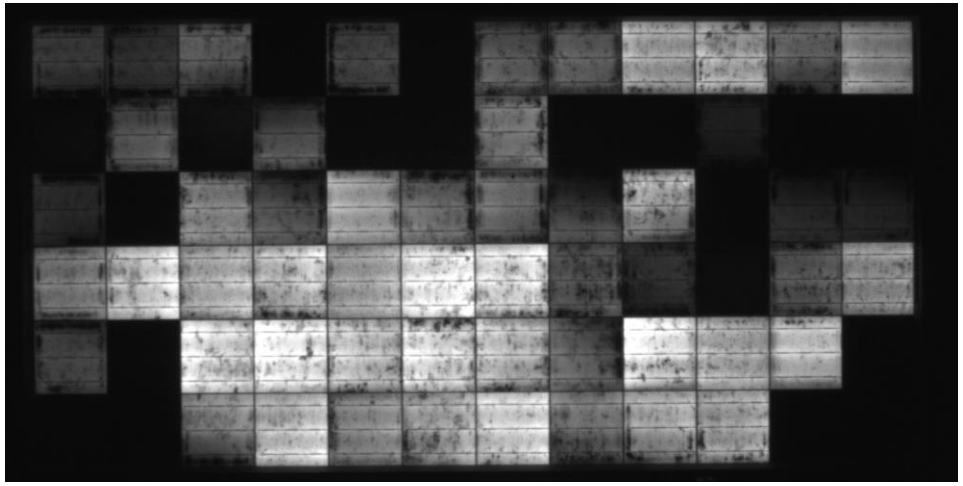
Failure Modes of PV modules:

Before PID testing



After PID testing



Hotspot Failure

Damp Heat Failures

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PV Services Accreditation

- NABL
- CBTL
- MNRE
- BIS

National Accreditation Board for Testing and Calibration Laboratories
(A Constituent Board of Quality Council of India)

CERTIFICATE OF ACCREDITATION

TUV RHEINLAND (INDIA) PRIVATE LIMITED

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2005

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

#82A, West Wing, 3rd Main Road, Electronics City, Phase-1, Bangalore, Karnataka

in the field of

TESTING

Certificate Number TC-5688 *(in lieu of T-1849, T-1542, T-1543 & T-2571)*

Issue Date 24/04/2017 Valid Until 23/04/2019

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.

(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Signed for and on behalf of NABL

N. Venkateswaran
Program Director

Anil Relia
Chief Executive Officer

International Electrotechnical Commission

IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components (IECEE)

CERTIFICATE OF ACCEPTANCE

TO PARTICIPATE IN THE IECEE CB-SCHEME

TUV Rheinland (India) Pvt. Ltd.

82/A, West Wing, 3rd Main Road, Electronics City Phase 1, Bangalore-560100, INDIA.

has been assessed and determined to fully comply with the requirements of ISO/IEC 17025: 2005-05, The Basic Rules, IECEE 01: 2014-11 and Rules of Procedure IECEE 02: 2015-06, and the relevant IECEE CB-Scheme Operational Documents.

TUV Rheinland (India) Pvt. Ltd.

is therefore entitled to operate as a CB Testing Laboratory under the responsibility of TUV RH Japan as National Certification Body and to carry out testing within the IECEE CB Scheme for the Scope (Product Category(ies) and Standard(s)) as listed in the relevant part of the IECEE Web Site at www.iecee.org, and is subject to all other terms as set forth in the IECEE Basic Rules and Rules of Procedure

This certificate remains valid until February 20th 2018 at which time it will be reissued by the IECEE Executive Secretary upon successful completion of the normally scheduled 3-year Reassessment Programme administered by the IECEE CB Scheme.

Signed by:

Kerry McMANAMA
IECEE EXECUTIVE SECRETARY AND CEO

Date of issue: 2016-07-21
TL332

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Fire Test

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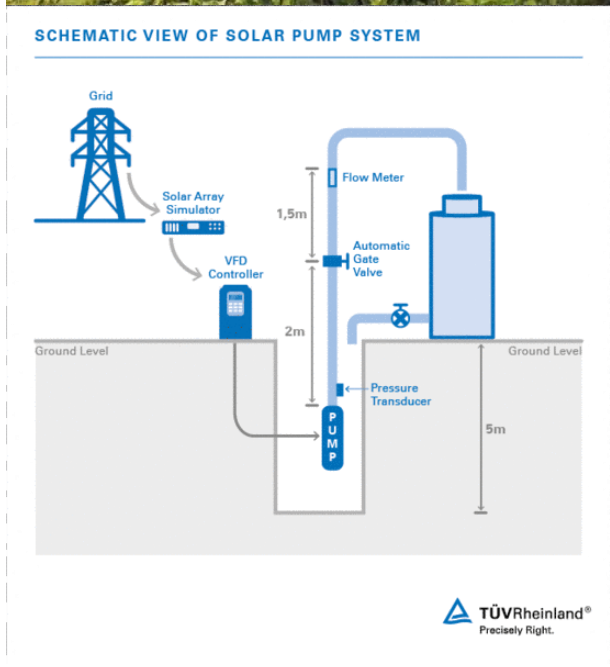
PV Services
Solar systems testing – MNRE requirement

- Solar water pump system
-
- Solar Home lighting system
- Solar street light system
- Solar power packs
- Solar Lantern



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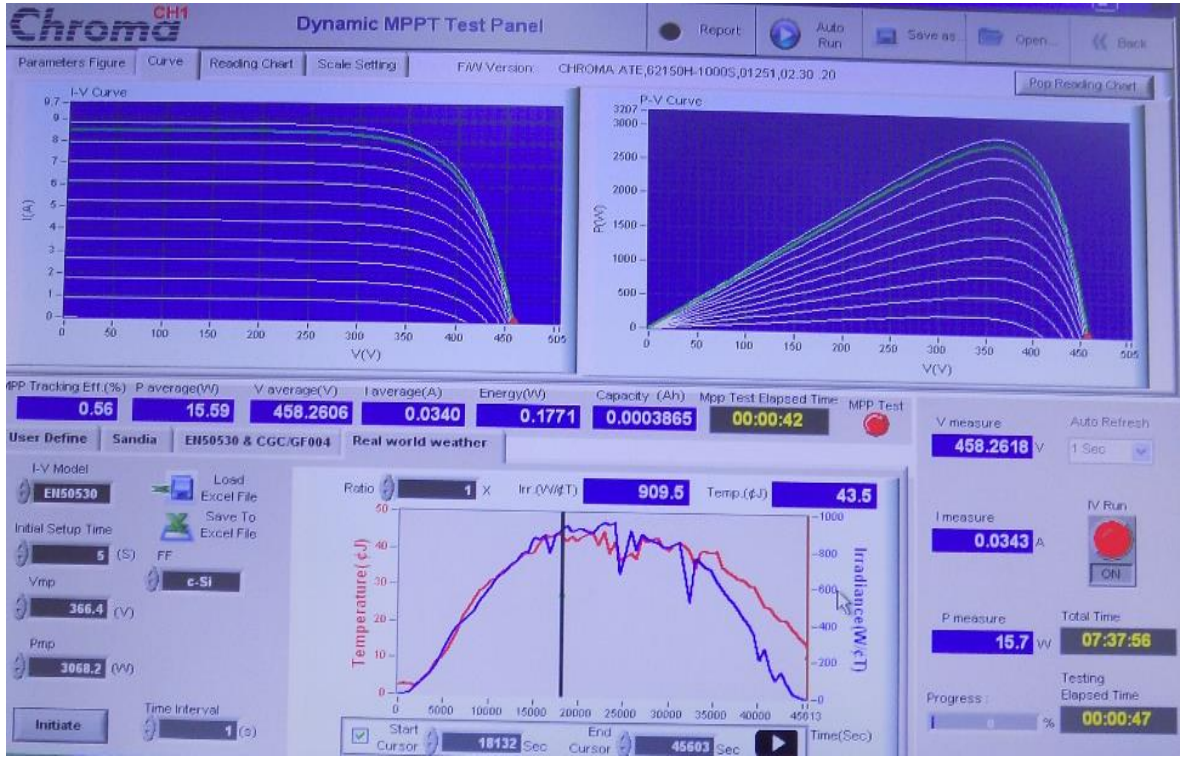
Test Profile Pics and Control Room of Test Setup



Automatic control Test Profiles

Automatic control Test Control room

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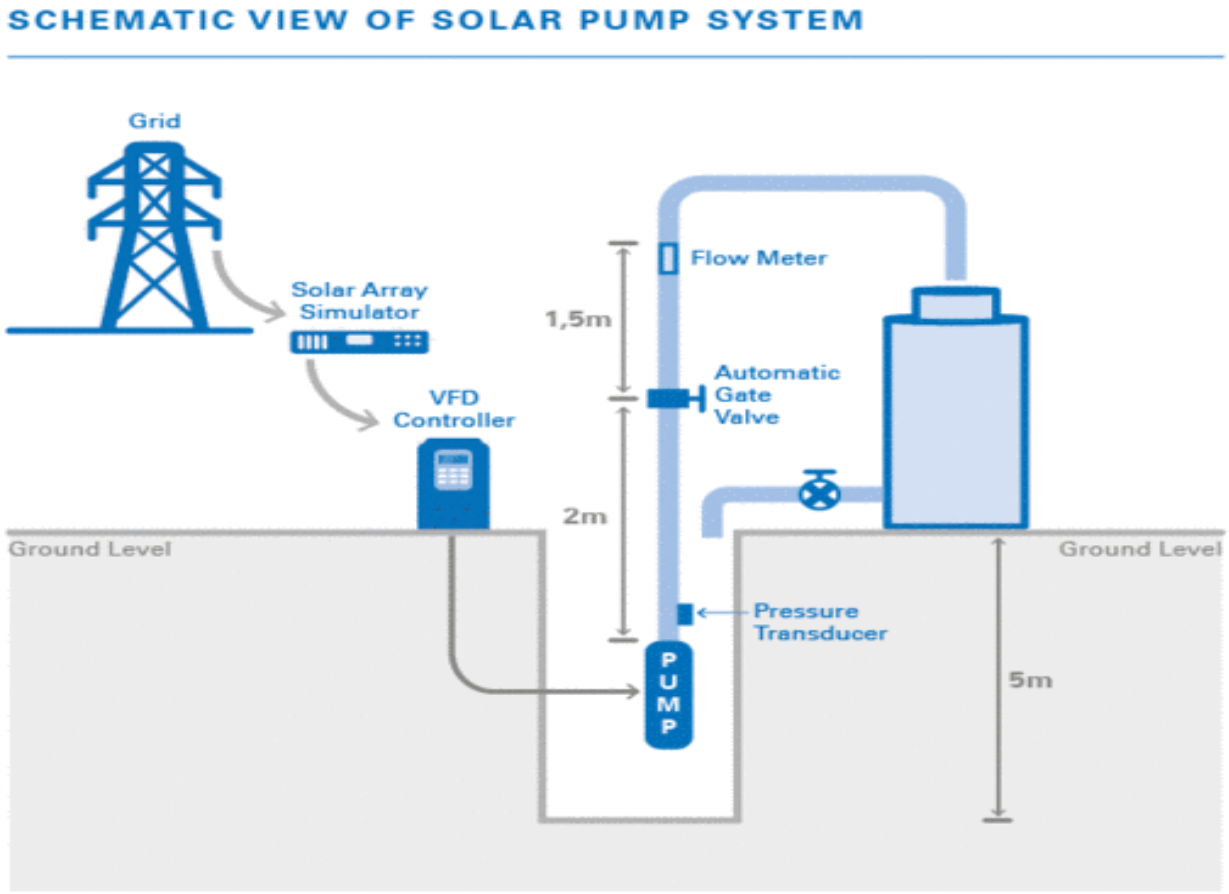
Test Execution Setup and working flow Diagram



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