

TEST REPORT

Report No. : S24033001202001

Product : Solar Panels

Model No. : ELEK425WM, ELEK10WM, ELEK20WM, ELEK50WM,
ELEK60WM, ELEK80WM, ELEK100WM, ELEK140WM,
ELEK150WM, ELEK160WM, ELEK200WM, ELEK220WM,
ELEK250WM, ELEK280WM, ELEK300WM, ELEK350WM,
ELEK410WM

Applicant : Distribuciones Solares del Principado S.L

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Spain



Issued by : Shenzhen NTEK Testing Technology Co., Ltd.

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| TEST REPORT EN IEC 61730-1:2018 AND EN IEC 61730-2: 2018 Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction Part 2: Requirements for testing | |
|--|--|
| Report Number | S24033001202001 |
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| Approved by | Gary Li  |
| Date of issue | 2024-04-16 |
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| Testing location | (Same as above) |
| Applicant Name | Distribuciones Solares del Principado S.L |
| Address | B74219346 Pl. Promogrande, 22 Granda Siero 33199 Asturias Spain |
| Test specification | |
| Standard | EN IEC 61730-1: 2018; EN IEC 61730-2: 2018 |
| Procedure deviation | N.A |
| Non-standard test method | N.A |
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| Test Item description | Solar Panels |
| Trade mark | Eleksol |
| Model | ELEK425WM, ELEK10WM, ELEK20WM, ELEK50WM, ELEK60WM, ELEK80WM, ELEK100WM, ELEK140WM, ELEK150WM, ELEK160WM, ELEK200WM, ELEK220WM, ELEK250WM, ELEK280WM, ELEK300WM, ELEK350WM, ELEK410WM |
| Manufacturer | Tangshan Jingxin Science And Technology Company Limited |
| Manufacturer address | Vineyard, North Zhaozhuang Village, Kaiping Town, Kaiping District, Tangshan City, Hebei, China. |
| Rating | Voc:38.53V, Vmp:31.91V, Imp:13.32A, Isc:14.08A, Pmax:425W |

| GENERAL INFORMATION | |
|--|---|
| Abbreviations used in the report: | |
| HF – Humidity Freeze | TC – Temperature Cycling |
| DH – Damp Heat | Vmp – Maximum power voltage |
| I _{mp} – Maximum power current | Voc – Open circuit voltage |
| I _{sc} - Short circuit current | FF – Fill Factor |
| P _{mp} – Maximum power | α – Current temperature coefficient |
| MQT – Module Quality Tests | β – Voltage temperature coefficient |
| STC – Standard Test Conditions | δ – power temperature coefficient |
| NMOT – Nominal Module Operating Temperature (20°C, 800 W/m ²) | VFM _{rated} – Rated diode(s) forward voltage |
| VFM – Measured diode(s) forward voltage | NP – Nameplate |
| m_1 – the measurement uncertainty in % of laboratory for P _{max} | m_2 – the measurement uncertainty in % of laboratory for Voc |
| m_3 – the measurement uncertainty in % of laboratory for I _{sc} | t_1 – the manufacturer’s rated lower production tolerance in % for P _{max} |
| t_2 – the manufacturer’s rated upper production tolerance in % for Voc | t_3 – the manufacturer’s rated upper production tolerance in % for I _{sc} |
| r – P _{max} measurement reproducibility | |
| Possible test case verdicts: | |
| - test case does not apply to the test object | (N)/A |
| - test object does meet the requirement..... | (P)ass |
| - test object does not meet the requirement..... | (F)ail |
| General remarks: | |
| <p>The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory. "(see Enclosure #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report.</p> <p>Throughout this report a comma (point) is used as the decimal separator.</p> <p>Unless otherwise specified, models ELEK425WM are chosen as representative models to perform all tests.</p> | |

Testing procedure

- New module type
- Modifications (if yes, please choose the applicable modification according to the Retesting Guideline)
- Change in cell technology Modification to encapsulation system Modification to superstrate
- Increase in module size Modification to backsheet/ substrate
- Modification to frame and/ or mounting structure Modification to junction box/ electrical termination
Change in cell interconnect materials or technique
- Change in electrical circuit of an identical package
- Higher or lower power output (by 10%) in the identical package including size and using the identical cell process
- Qualification of a frameless module after the design has received certification as a framed module
- Change in bypass diode or number of diodes

10 TEST PROCEDURES (if it is not a full test, strikethrough non-performed test)

Note: Deviations from test sequence are possible but must be documented.

8 Modules
Preconditioning

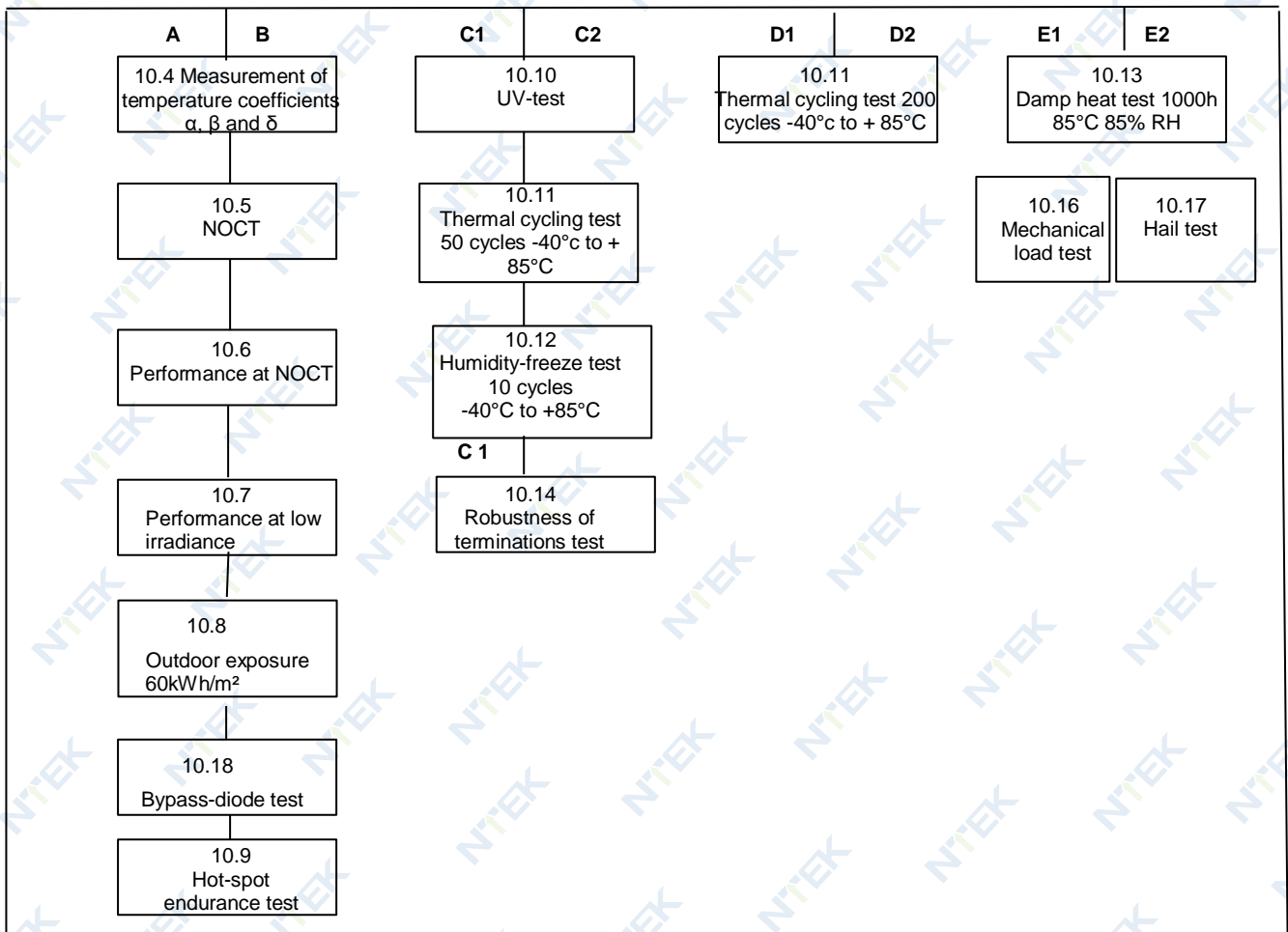
Initial

10.1
Visual Inspection

10.2
Maximum Power determination

10.3
Insulation test

10.15
Wet leakage current test



10.15
Wet leakage current test

Final

| EN IEC 61730-2 | | | |
|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

4 CLASSIFICATION, APPLICATIONS AND INTENDED USE

4.1 General

| | | | |
|--|---|--|---|
| | The module has been evaluated for the following Class (IEC 61140).....: | <input type="checkbox"/> Class 0 <input type="checkbox"/> Class II <input checked="" type="checkbox"/> Class III | — |
|--|---|--|---|

4.5 Intended use



| | | | |
|--|---|---|---|
| | PV modules are installed in the following special applications: | | — |
| | Building attached PV (BAPV) | <input type="checkbox"/> yes <input checked="" type="checkbox"/> no | — |
| | Building integrated PV (BIPV) | <input type="checkbox"/> yes <input checked="" type="checkbox"/> no | — |
| | Applications in areas where snow and / or wind load exceeding loads as tested in IEC 61730-2 are expected | <input type="checkbox"/> yes <input checked="" type="checkbox"/> no | — |
| | Applications at environmental temperature exceeding the limits indicated in of IEC 61730-1:2016 | <input type="checkbox"/> yes <input checked="" type="checkbox"/> no | — |
| | other (please specify) | <input checked="" type="checkbox"/> yes, as follows: Portable outdoor products <input type="checkbox"/> no | — |

5 REQUIREMENTS FOR DESIGN AND CONSTRUCTION

5.1 General

| | | | |
|--|---|--|---|
| | PV module suitable for operation in outdoor non-weather protected locations, exposed to direct and indirect (albedo) solar radiation, in an environmental temperature range of at least -40°C to +40°C and up to 100 % relative humidity as well as rain. | | P |
| | Product shipped from the factory as | <input checked="" type="checkbox"/> completely assembled <input type="checkbox"/> subassemblies | — |
| | The provided assemblies of the product do not involve any action that is likely to affect compliance with the requirements of the IEC 61730 series. | | P |
| | Incorporation of a PV module into the final assembly does not require any alteration of the PV module from its originally evaluated form. | | P |
| | Equipotential bonding continuity is not interrupted by installation | | P |
| | Any adjustable or movable structural part are provided with a locking device | | P |
| | PV modules have no accessible burrs, sharp edges or sharp points | See Table 45 | P |
| | Parts are prevented from loosening or turning | See Table 47 and 48 | P |

| EN IEC 61730-2 | | | |
|--------------------------------------|--|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| 5.2 Marking and documentation | | | |
| 5.2.1 | Instructions related to safety are in an official language of the country where the equipment is to be installed. | | P |
| 5.2.2 Marking | | | |
| 5.2.2.1 General | | | |
| | Each PV module includes the following clear and indelible markings: | | — |
| | a) Name, registered trade name, or registered trade mark of manufacturer | | P |
| | b) Type or model number designation | | P |
| | c) Serial number | | P |
| | d) Date and place of manufacture; alternatively serial number assuring traceability of date and place of manufacture | | P |
| | e) Polarity of terminals or leads | | P |
| | f) —Maximum system voltage U_{sys} or U_{sys} | | P |
| | g) Class of protection against electrical shock, in accordance with Clause 4 of IEC 61730-1:2016 | | P |
| | h) —Voltage at open-circuit U_{oc} or — U_{oc} including manufacturing tolerances | | P |
| | i) —Current at short-circuit I_{sc} or — I_{sc} including manufacturing tolerances | | P |
| | j) —PV module maximum power P_{max} or — P_{max} including manufacturing tolerances | | P |
| | k) —Maximum overcurrent protection rating I_{oc} | | N |
| | All electrical data are shown as relative to standard test conditions (STC) ($1\ 000\ W/m^2$, $(25 \pm 2)\ ^\circ C$, AM 1.5 according to IEC 60904-3). | | P |
| | International symbols are used where applicable. | | P |
| | PV connectors or wiring are marked in accordance to IEC 62852 with a symbol „Do not disconnect under load“. | | P |
| | Symbol or warning notice are imprinted or labelled close to connector | | P |
| | PV connectors are clearly marked indicating the terminal polarity. | | P |
| | For Class II and Class 0 PV modules, the (IEC 60417-6042: Caution, risk of electric shock) symbol is applied near the PV module electrical connection means. | | N |

| EN IEC 61730-2 | | | |
|--|--|---|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | PV modules are marked to indicate the class | <input type="checkbox"/> class II:  <input checked="" type="checkbox"/> class III:  <input type="checkbox"/> class 0: no symbol | P |
| | PV modules provided with a functional earth connection (see section 5.2.2.2.2) | — | — |
| | PV modules with terminals for field wiring rated only for use with copper wire are marked, at or adjacent to the terminals, with the statement "Use copper wire only", "Cu only", or the equivalent. | | N |
| | PV modules with terminals for field wiring rated only for use with a different specific wiring material are marked with a similar statement referring to the rated material. | | N |
| 5.2.2.2 Symbols | | | |
| 5.2.2.2.1 Equipotential bonding | | | |
| | Bonding conductor for equipotential bonding is identified with: | ; | N |
| | No other terminal or location is identified in this manner | | P |
| 5.2.2.2.2 Functional earthing | | | |
| | Field installed functional earthing conductor is identified with the symbol: | | N |
| 5.2.3 Documentation | | | |
| | Documentation concerning electrical and mechanical installation provided. | | N |
| | Class (see 5.2.2.1) is stated, including specific limitations required for that Class. | | P |
| | Environmental conditions to which the module has been qualified are stated. | | — |
| | concerning temperature range, typically -40 °C to +40 °C | | P |
| | concerning wind/snow load including safety factor | | P |
| | Documentation for safe installation, use, and maintenance is available for installers and operators. | | P |
| | The documentation contains the following information: | | — |
| | – Name, registered trade name, or registered trade mark of manufacturer | | P |
| | – Type or model number designation | | P |
| | – —Maximum system voltage U_{ll} or U_{llsys} | | P |
| | – Class of protection against electrical shock | | P |

| EN IEC 61730-2 | | | |
|----------------|---|---|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | – Voltage at open-circuit V_{oc} including manufacturing tolerances at STC | | P |
| | – Current at short-circuit I_{sc} including manufacturing tolerances at STC | | P |
| | – PV module maximum power P_{max} including manufacturing tolerances at STC | | P |
| | – Maximum overcurrent protection rating I_{oc} | See Table 34 | N |
| | – Recommended maximum series / parallel PV module configurations | | N |
| | – Temperature coefficient for voltage at open-circuit | | — |
| | – Temperature coefficient for maximum power | | — |
| | – Temperature coefficient for short-circuit current | | — |
| | All electrical data shall be shown as relative to standard test conditions (1000 W/m^2 , $(25 \pm 2) \text{ }^\circ\text{C}$, AM 1.5 according to IEC 60904-3). | | P |
| | International symbols are used | | P |
| | The electrical documentation includes a detailed description of the electrical installation wiring, including: | | P |
| | – Minimum cable diameters for PV modules intended for field wiring | | P |
| | – Limitations on wiring methods and wire management that apply to the junction box for the PV module | | P |
| | – Size, type, material, and temperature rating of the conductors | | P |
| | – Type of terminals for field wiring | | P |
| | – Specific PV connector model / types and manufacturer to which the PV module connectors can be mated | | P |
| | – The bonding method(s), if applicable, is specified including all provided or specified hardware | | P |
| | – The type and ratings of bypass diode to be used (if applicable) | | N |
| | – Limitations to the mounting situation (e.g. slope, mounting means, cooling) | | P |
| | – A statement indicating | fire rating(s) and applied standards statement regarding resistance to external fire sources not evaluated | P |

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|----------------|---|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | – Limitations regarding fire ratings (e.g. installation slope, sub structure or other applicable installation information) | | N |
| | – A statement indicating the minimum mechanical means for securing the PV module | | N |
| | – A statement indicating the maximum altitude | | N |
| | The documentation for roof mounting includes: | | — |
| | – A statement indicating the minimum mechanical means for securing the PV module to the roof | | N |
| | – Specific parameter(s) when the fire rating is dependent on a specific mounting structure are provided e.g. specific spacing, or specific means of attachment to the roof or structure. | | N |
| | A statement concerning artificially concentrated sunlight | | N |
| | Assembly instructions are provided with a product shipped in subassemblies, and are detailed and adequate to the degree required to facilitate complete and safe assembly of the product | | N |
| | The installation instructions include relevant parameters specified by manufacturer or the following statement or the equivalent: <i>"Under normal conditions, a photovoltaic module is likely to experience conditions that produce more current and/or voltage than reported at standard test conditions. Accordingly, the values of ISC and VOC marked on this module should be multiplied by a factor of 1,25 when determining component voltage ratings, conductor current ratings, and size of controls connected to the PV output."</i> | | N |

5.3 Electrical components and insulation

5.3.2 Internal wiring

| | | | |
|--|--|--|---|
| | Internal wiring has sufficient current carrying capacity for the relevant application. | | P |
|--|--|--|---|

5.3.3 External wiring and cables

| | | | |
|--|--|---|---|
| | External wires and cables fulfil the requirements of | <input checked="" type="checkbox"/> EN 50618 <input type="checkbox"/> IEC 62930. | P |
|--|--|---|---|

5.3.4 Connectors

| | | | |
|--|--|--|---|
| | External DC connectors fulfil the requirements of IEC 62852. | | P |
|--|--|--|---|

| EN IEC 61730-2 | | | |
|--|---|--|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| 5.3.5 Junction boxes for PV modules | | | |
| | Junction boxes for PV modules fulfil the requirements of IEC 62790. | | P |
| 5.3.6 Frontsheets and backsheets | | | |
| | Frontsheet: | | — |
| | Material Frontsheet: | <input checked="" type="checkbox"/> Glass <input type="checkbox"/> Polymeric material <input type="checkbox"/> Others. | — |
| | Polymeric frontsheets meet relevant requirements of section 5.5.2 | See 5.5.2 | P |
| | Polymeric frontsheets used as relied upon insulation fulfil requirements of | | — |
| | - 5.6.4.3 for insulation in thin layers | See 5.6.4.3 | P |
| | - 5.5.2.3 for electrical insulation | See 5.5.2.3 | P |
| | Thermal index frontsheet (see also 5.5.2.3.3): | <input type="checkbox"/> TI : <input checked="" type="checkbox"/> RTE : <input type="checkbox"/> RTI : | — |
| | Adhesion to encapsulant or glass is appropriate | Compliance is checked by test sequences of IEC 61730-2 listed in this report. | P |
| | Backsheet: | | — |
| | Material Backsheet: | <input type="checkbox"/> Glass <input checked="" type="checkbox"/> Polymeric material <input type="checkbox"/> Others. | — |
| | Polymeric backsheets meet relevant requirements of section 5.5.2 | See 5.5.2 | P |
| | Polymeric backsheets used as relied upon insulation fulfil requirements of | | P |
| | - 5.6.4.3 for insulation in thin layers | See 5.6.4.3 | P |
| | - 5.5.2.3 for electrical insulation | See 5.5.2.3 | P |
| | Thermal index backsheet (see also 5.5.2.3.3): | <input type="checkbox"/> TI : <input checked="" type="checkbox"/> RTE : <input type="checkbox"/> RTI : | — |
| | Adhesion to encapsulant or glass is appropriate | Compliance is checked by test sequences of IEC 61730-2 listed in this report. | P |
| 5.3.7 Insulation barriers | | | |
| | Polymeric insulation barrier meets the relevant requirements of 5.5.2 | See 5.5.2 | P |
| | Barrier held in place while keeping its required electrical and mechanical properties | | P |
| | Removal of barrier only possible by using a tool | | P |
| 5.3.8 Electrical connections | | | |
| 5.3.8.1 General | | | |

| EN IEC 61730-2 | | | |
|---|--|--|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | Terminations are so designed, that the contact pressure is not transmitted through insulating material except ceramic, mica or other adequate material. Compliance checked by MST 01 | | P |
| | Measures are taken to prevent connections becoming loose, e.g. by using a washer. | See Table 11 and Table 48 | P |
| | End of a stranded conductor is not consolidated by soft soldering. | | P |
| | Measures are taken to prevent contact stress impairing electrical conductivity. | | P |
| 5.3.8.2 Terminals for external cables and PV connector ribbons | | | |
| | Terminals for electrical connections are suitable for the type and range of conductor cross-sectional areas and meet the relevant requirements of IEC 62790. | | P |
| | Insulated terminals are designed such that a reduction of clearances and creepage distances by displacement is prevented. | | P |
| 5.3.8.3 Splices and connections inside a PV module | | | |
| | Splices and connections are mechanically secured and provide electrical continuity. | | P |
| | Electrical connections are soldered, welded, conductively adhered, crimped, or otherwise securely connected. | | P |
| | A soldered or conductively adhered joint is additionally mechanically secured. | | P |
| 5.3.9 Encapsulants | | | |
| | Thermal properties are sufficient for intended application. | | P |
| | The insulation properties according to 5.5.2.3 are met, if applicable. | See 5.5.2.3.2 | P |
| 5.3.10 Bypass diodes | | | |
| | Bypass diodes are rated to withstand the current and voltage for their intended use. | See Table 31 and Table 46 | N |
| 5.4 Mechanical and electromechanical connections | | | |
| 5.4.1 General | | | |
| | Type of connection: | <input type="checkbox"/> Connection within <input type="checkbox"/> frame Mounting <input type="checkbox"/> interfaces via adhesive <input type="checkbox"/> frame to clamp a mounting system <input type="checkbox"/> Equipotential bonding <input type="checkbox"/> Attachment of junction box <input type="checkbox"/> mechanical connections within the laminate | N |

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|------------------------------------|---|-------------------------------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | Mechanical connections are durable to withstand the thermal, mechanical, and environmental stresses occurring in the application. | See Table 38, Table 13 and Table 11 | P |
| | Removable parts are only detachable with the aid of tools. | | P |
| | Lids attached without screws have one or several detectable facilities for enabling tools. | | P |
| | No contact of tools with the live parts when the lid is removed. | | P |
| | No friction between surfaces as the sole means to inhibit the turning or loosening of a part, unless provisions to prevent unintended movement or rotation of the component is given. | | N |
| 5.4.2 Screw connections | | | |
| | Screws and mechanical connections withstand the mechanical stresses occurring in normal use. | | P |
| | Screws are not made of a material which is soft or liable to creep. | | P |
| | Screws used to provide mechanical stability and continuity for equipotential bonding withstand the mechanical stresses occurring in normal use. | | P |
| | At least one screw per electrical- mechanical connection ensures the electrical connection between the metallic components | | P |
| | Screws used for mechanical and electrical connections with a nominal diameter of less than 3 mm are screwed into metal. | | P |
| | For screws used for mechanical and electrical connections two full threads are engaged into the metal. | | P |
| | Screwed and other fixed connections are in such a way that they do not come loose through torsion, bending stresses, vibration, etc. | | P |
| 5.4.3 Rivets | | | |
| | Rivets which serve as electrical as well as mechanical connections are locked against loosening. | | P |
| 5.4.4 Thread-cutting screws | | | |
| | Thread-cutting and self-tapping screws are not used for interconnection of current-carrying parts made of a material which is soft or liable to creep. | | P |
| | No thread-forming or thread-cutting (self-tapping) screws (sheet metal screws) are used for the connection of current-carrying parts. | | P |
| | Thread-cutting (self-tapping) screws not be used if they are likely to be operated by the user or installer. | | N |

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|---------------------------------------|--|--|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | Thread-cutting and thread-forming screws, used to provide continuity for equipotential bonding, are such that it is not necessary to disturb the connection in normal use. | | N |
| | For equipotential bonding one screw is permitted if two full threads engage the metal | | N |
| 5.4.5 Form/press / tight fit | | | |
| | Form/press/tight fits of metallic components which are not separately equipotentially bonded are electrically connected. | | P |
| | Requirements of MST 32 and MST 34 are met, continuity of equipotential bonding (MST 13) is provided before and after the MST 32 and MST 34 tests | See Table 38, Table 39 and Table 11 | P |
| 5.4.6 Connections by adhesives | | | |
| | Connections by adhesive for mounting means are sufficient. | See Table 38, Table 39 and Table 11 | N |
| | Fixing of junction box by adhesive is sufficient. | See Table 27, and Table 10 | N |
| | Adhesion of a polymer relied upon for insulation to another insulating layer is appropriate for the application. | | P |
| | Requirements for adhesive materials are met | See 5.5.4 | P |
| | Connection by adhesive which is considered as cemented joint fulfils the requirements of 5.6.4.2. | See 5.6.4.2 | P |
| 5.4.7 Other connections | | | |
| | Other connections such as, welded or soldered, as well as Materials and processes for creating the connections are appropriate for the application and for the intended use. | See Table 6 and Table 43 | P |
| | Other connections which are relied upon for equipotential bonding fulfil the requirements of (MST 13). | See Table 11 | N |
| 5.5 Materials | | | |
| 5.5.2 Polymeric materials | | | |
| 5.5.2.1 General | | | |
| | Polymeric materials are able to durably and safely withstand the electrical, mechanical, thermal, environmental, and corrosive stresses occurring in the application. | Assessed polymeric parts see Annex 2 (BOM). Test results see subsequent sections | P |
| | Polymeric materials are resistant to electrical and mechanical property degradation. | Test results see subsequent sections | P |
| | Polymeric parts which ensure either the electrical or mechanical safety of the PV module, or both, are resistant to electrical and mechanical property degradation. | Test results see subsequent sections | P |

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|--|---|--|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | They comply with the requirements of the materials creep test (MST 37) depending on their constructive function in the PV module. | See Table 13 | P |
| | Polymeric material used as a part of a cemented joint fulfils additionally the requirements of 5.6.4.2. | See 5.6.4.2 | P |
| 5.5.2.2 Endurance to weathering stress | | | |
| | Polymeric materials of the module and its components are durable to weathering stress. | Test results see subsequent sections | P |
| 5.5.2.3 Polymeric materials used as electrical insulation | | | |
| 5.5.2.3.1 General | | | |
| | Material relied upon for insulation are of adequate thickness, as described in Tables 3 and 4. | See Table 49 and Annex 2 (BOM) | N |
| | The temperature limits of materials used as insulation are not less than the maximum measured operating temperature of the specific material in application, as measured during the temperature test (MST 21). | See Table 32 | P |
| 5.5.2.3.2 Endurance to electrical stress | | | |
| | Materials used as electrical insulation are in compliance with the insulation coordination requirements | See 5.6.3 | P |
| 5.5.2.3.3 Endurance to thermal stress | | | |
| | Materials used as relied upon insulation have a mechanical and electrical relative thermal endurance, relative thermal index or temperature index (RTE/RTI or TI) appropriate for the application, at least 90 °C. | <input type="checkbox"/> TI : <input checked="" type="checkbox"/> RTE : <input type="checkbox"/> RTI : Assessed polymeric parts see Annex 2 (BOM) See Table 32 | P |
| 5.5.2.3.4 Polymeric insulating materials used as external parts | | | |
| | External polymeric parts of the PV module meet the following requirements: | | — |
| | - flammability class minimum V-1 | | P |
| | - ball pressure test with a temperature of 75 °C | | P |
| | - ignitability test in final application | See Table 37 | P |
| | - peel test of cemented joints | See Table 39 | P |
| | - lap shear strength test | See Table 40 | N |
| 5.5.2.3.5 Polymeric insulating parts supporting live parts | | | |
| | External parts of insulating material supporting live parts including connections, and parts of polymeric material providing supplementary insulation or reinforced insulation, are sufficiently resistant to heat. | | P |
| | Polymeric parts which are not components of the laminate fulfil the requirements of ignitability test | | P |
| | Other than elastomeric polymeric materials meet the following requirements: | | — |

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|--|--|---|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | - flammability class minimum HB | Assessed polymeric parts see Annex 2 (BOM) | N |
| | - ball pressure test with a temperature of 125 °C | | N |
| | - material creep test | See Table 13 | P |
| 5.5.2.4 Polymeric materials used for mechanical functions | | | |
| | Materials used for mechanical functions have a mechanical relative thermal endurance, relative thermal index or temperature index (RTE/RTI or TI) appropriate for the application, at least 90 °C. | <input type="checkbox"/> TI : <input checked="" type="checkbox"/> RTE : <input type="checkbox"/> RTI : | P |
| 5.5.3 Metallic materials | | | |
| 5.5.3.1 General | | | |
| | Metal parts are not in contact to metal parts having a difference of their electrochemical potentials of more than 600 mV. | Assessed parts see Annex 2 (BOM) | N |
| | Iron or mild steel are plated, painted, or enamelled for protection against corrosion. | | N |
| | Corrosion protection is at least equivalent to a zinc coating of 0.015 mm thickness | Assessed parts see Annex 2 (BOM) See Table 6 | N |
| 5.5.3.2 Current carrying parts | | | |
| | Assessed parts: | | P |
| | Current-carrying parts have sufficient mechanical strength and electrical conductivity. | See Table 32 See Table 34 See Table 11 | P |
| | Current-carrying materials are protected against corrosion. | | P |
| | The coating for protective coated metal is capable of preventing corrosion according to either one of the listed standards. | <input type="checkbox"/> ISO 1456 <input checked="" type="checkbox"/> ISO 1461 <input type="checkbox"/> ISO 2081 <input type="checkbox"/> ISO 2093 | P |
| | Coated metal not used if the current-carrying parts are stressed by abrasion. | | N |
| 5.5.4 Adhesives | | | |
| | Adhesives are appropriate for the application. | See Tables 40, Table 39, Table 27, Table 29, Table 12, and Table 10 | P |
| | Adhesive as part of the relied upon electrical insulation meets the requirements of 5.5.2.3.3 | See 5.5.2.3.3 | P |
| 5.6 Protection against electric shock | | | |
| 5.6.1 General | | | |
| | Adequate protection against contact with hazardous live parts provided | | P |

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|--|---|--------------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | Specimen pose no risk of electric shock. | | P |
| 5.6.2 Protection against accessibility to hazardous live parts | | | |
| 5.6.2.1 General | | | |
| | Class of module | See safety ratings | — |
| | For class 0 and Class II modules adequate protection against accessibility to hazardous live parts (> 35 V DC) provided. | See Table 12 | N |
| Table 2 of 5.6.2.3 | For Class 0 PV modules, accessible metal parts and accessible surfaces as well as live parts of different potential of the same circuit are separated by at least basic insulation. | | N |
| | For Class II PV modules construction provide separation between accessible parts or accessible surfaces and hazardous live parts by double or reinforced insulation. | | N |
| Table 2 of 5.6.2.3 | For Class II PV modules, live parts of different potential of the same circuit are separated by double or reinforced insulation. | | N |
| | For Class III PV modules separation between accessible parts or accessible surfaces and hazardous live parts by functional insulation. | | P |
| Table 2 of 5.6.2.3 | In Class III PV modules live parts of different polarity are separated by at least functional insulation. | | P |
| | Materials used for realizing protection against accessibility of hazardous live parts by means of enclosure, insulation barrier or relied upon insulation comply with the requirements of 5.5.2 due to their application. | | P |
| 5.6.2.2 Protection by means of enclosures and insulation barriers | | | |
| | Enclosures or insulation barriers are so designed that, after mounting, the live parts are not accessible (even after possible deformation) | | P |
| | Degree of protection of the housing is not impaired by any possible deformation. | | P |
| | Parts of enclosures and insulation barriers that provide protection are not removable without the use of a tool. | | P |
| | Lids which are attached without screws have one or several detectable features, e.g. recesses, | | P |
| | Tool to open the lid do not come into contact with the live parts if lid is removed correctly. | | P |
| | Insulation barrier are held in place and are not affected by influences expected during normal operation. Electrical and mechanical properties don't fall below the minimum acceptable values for the application. | | P |

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|--|--|---|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | Parts are prevented from loosening or turning. | | P |
| 5.6.2.3 Protection by means of insulation of live parts | | | |
| | Insulation materials providing the sole insulation between a live part and an accessible metal part, or between uninsulated live parts not of the same potential, are of adequate thickness and of a material appropriate for the application. | | P |
| | Requirements of Table 2 | see 5.6.2.1 of this report | — |
| 5.6.3 Insulation coordination | | | |
| 5.6.3.1 | Components comply with the requirements for their relevant standards | See Annex 2 | P |
| 5.6.3.2 | Pollution degree | See Table 1, Table 2, Table 3 | — |
| 5.6.3.3 | Material group | See Table 1, Table 2, Table 3 | — |
| 5.6.3.4 | Clearance and creepage distance | | N |
| | Derating factor for altitude above 2000 m is considered | | N |
| 5.6.4 Distance through insulation (dti) | | | |
| 5.6.4.1 General | | | |
| | Polymeric materials for cemented insulation parts and insulation in thin layers shall withstand environmental, thermal, electrical and mechanical stresses as far as they occur. | See 5.5.2 | P |
| | Distances through insulation (dti) of solid insulation comply with the minimum distance as required: | | N |
| | System voltage.....: | See safety ratings | — |
| | Distance through insulation req./meas. (mm): | | N |
| | The insulation fulfils the material classification as given in IEC 60216-1, IEC 60216-2 and IEC 60216-5 (RTE/TI/RTI). | See annex 2 | N |
| 5.6.4.2 Cemented joints | | | |
| | Cemented joints were considered as | <input checked="" type="checkbox"/> Edge seal <input checked="" type="checkbox"/> Interface between Junction Box and mounting surface <input type="checkbox"/> others | — |
| | Distances along cemented joints comply with the minimum distances as required in table 3 or table 4: | | N |
| | System voltage.....: | See safety ratings | P |
| | Distance along cemented joints req./meas. | | N |
| | A distance can be considered as cemented joint if following requirements are met: | | — |

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|----------------|--|--|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | - Neither cracks nor voids in the insulating compounds have been occurred which either by themselves or in combination reduces the distances through the cemented joint below the required values. | | P |
| | - No breakdown at MST 16 (initial and final test)with a 1,35 times higher tests voltage: | No breakdown | P |
| | Test voltage (V): | | — |
| | No breakdown at MST 17 (initial and final test)with a 1,35 times higher tests voltage: | No breakdown | P |
| | Test voltage (V): | | — |
| | The electrically insulating adhesive/sealant have a volume resistivity: | | — |
| | - of greater than $50 \times 10^6 \Omega \text{ cm}$ (dry) | | P |
| | - and greater than $10 \times 10^6 \Omega \text{ cm}$ (wet). | | N |
| | rigid / rigid: lap shear test MST 36 rigid / flexible: Peel test MST 35 | See Table 40 and Table 39 | P |
| | Supplement information: Above mentioned tests have to be performed for each cemented joint. Also the materials and their properties have to be listed in annex 1 | | |
| 5.6.4.3 | Insulation in thin layers | | N |
| | Relied upon insulation in thin layers is applied at | <input checked="" type="checkbox"/> Backsheet <input type="checkbox"/> Front sheet <input checked="" type="checkbox"/> insulation within laminate <input type="checkbox"/> others | P |
| | Initial Construction of Insulation in thin layers complies with requirements concerning thickness under consideration of figure 4 as described in table 3 or 4 | See Annex 2 | N |
| | Construction of Insulation in thin layers complies with requirements concerning RTE/TI/RTI | See Annex 2 | N |
| | Insulation in thin layers provide sufficient dielectric strength: | See Annex 2 | N |
| | Test voltage for single-layer sheet and for entire multi-layer sheet providing relied upon insulation (2000V + 4 times system voltage).....: | See Annex 2 | N |
| | Test voltage for each layer of a multi-layer providing relied upon insulation (1000V + 2 times system voltage).....: | See Annex 2 | N |
| | Informative parameter evaluated according to IEC 62788-2 are presented | See Annex 2 | N |
| | Single-layer sheet as well as entire multi-layer sheet in final application comply with following: | | N |
| | - Minimum thickness according to lines 1b) of Table 3 and Table 4, (not less than $30\mu\text{m}$) req./meas. (mm),: | See Table 49 | N |

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| Clause | Requirement + Test | Result - Remark | Verdict |
|--------|--|-----------------|---------|
| | <ul style="list-style-type: none"> - Dielectric strength for basic insulation is provided after cut susceptibility test (MST 12) (1000V + 2 times system voltage) | See Table 41 | N |
| | Test voltage (V): | | N |

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|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

8 TESTING

TEST SEQUENCES SEE IEC 61730-2

Deviations from test sequence are possible but must be documented. See also table 5-

10 TEST PROCEDURES

10.1 General: Safety qualification testing included the following Module Safety Tests (MST) of IEC 61730-2

Initial Testing

| | | | |
|-------|--|-----------------------|---|
| 10.2 | MST 01 – Visual inspection | See appended Table 6 | P |
| 10.3 | MST 02 - Performance at STC | See appended Table 7 | P |
| 10.4 | MST 03 – Maximum power determination..... | See appended Table 8 | P |
| 10.13 | MST 16 – Insulation test..... | See appended Table 9 | P |
| 10.14 | MST 17 – Wet leakage current test..... | See appended Table 10 | N |
| 10.11 | MST 13 – Continuity test of equipotential bonding: | See appended Table 11 | N |
| 10.9 | MST 11 – Accessibility test..... | See appended Table 12 | N |

Sequence A

| | | | |
|-------|--|-----------------------|---|
| 10.26 | MST 37 – Materials creep test..... | See appended Table 13 | P |
| 10.11 | MST 13 – Continuity test of equipotential bonding: | See appended Table 11 | N |
| 10.9 | MST 11 – Accessibility test..... | See appended Table 12 | N |

Sequence B

| | | | |
|-------|---|-----------------------|---|
| 10.30 | MST 53 – Damp heat test 200h..... | See appended Table 14 | P |
| 10.31 | MST 54 – UV test 60kWh/m ² | See appended Table 15 | P |
| 10.29 | MST 52 – Humidity freeze test | See appended Table 16 | P |
| 10.31 | MST 54 – UV test 60kWh/m ² | See appended Table 17 | P |
| 10.29 | MST 52 – Humidity freeze test | See appended Table 18 | P |

Sequence B1

| | | | |
|-------|--------------------------------------|-----------------------|---|
| 10.32 | MST 55 – Cold conditioning | See appended Table 19 | P |
| 10.33 | MST 56 – Dry heat conditioning | See appended Table 20 | P |
| 10.29 | MST 52 – Humidity freeze test | See appended Table 21 | P |
| 10.32 | MST 55 – Cold conditioning | See appended Table 22 | P |
| 10.29 | MST 52 – Humidity freeze test | See appended Table 23 | P |

Sequence C

| | | | |
|-------|---|-----------------------|---|
| 10.31 | MST 54 – UV test 15kWh/m ² | See appended Table 24 | P |
|-------|---|-----------------------|---|

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|----------------------------|--|-----------------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| 10.28 | MST 51 – Thermal cycling 50 test.....: | See appended Table 25 | P |
| 10.29 | MST 52 – Humidity freeze test.....: | See appended Table 26 | P |
| 10.27 | MST 42 – Robustness of terminations test.....: | See appended Table 27 | P |
| Sequence D | | | |
| 10.30 | MST 53 – Damp heat test.....: | See appended Table 28 | P |
| 10.23 | MST 34 – Static mechanical load test.....: | See appended Table 29 | P |
| Sequence E | | | |
| 10.28 | MST 51 – Thermal cycling 200 test.....: | See appended Table 30 | P |
| Sequence F | | | |
| 10.19 | MST 25 – Bypass diode thermal test.....: | See appended Table 31 | P |
| 10.15 | MST 21 – Temperature Test.....: | See appended Table 32 | P |
| 10.16 | MST 22 – Hot-spot endurance Test.....: | See appended Table 33 | P |
| 10.20 | MST 26 – Reverse current overload test.....: | See appended Table 34 | N |
| Sequence G | | | |
| 10.12 | MST 14 – Impulse voltage test.....: | See appended Table 35 | N |
| Other tests | | | |
| 10.17 | MST 23 – Fire Test.....: | See appended Table 36 | N |
| 10.18 | MST 24 – Ignitability test.....: | See appended Table 37 | P |
| 10.21 | MST 32 – Module breakage test.....: | See appended Table 38 | P |
| 10.24 | MST 35 – Peel test.....: | See appended Table 39 | P |
| 10.25 | MST 36 – Lap shear strength test.....: | See appended Table 40 | N |
| Final Testing | | | |
| 10.10 | MST 12 – Cut susceptibility test.....: | See appended Table 41 | N |
| 10.11 | MST 13 – Continuity test of equipotential bonding: | See appended Table 11 | N |
| 10.9 | MST 11 – Accessibility test.....: | See appended Table 12 | N |
| 10.4 | MST 03 – Maximum power determination.....: | See appended Table 42 | P |
| 10.1 | MST 01 – Visual inspection.....: | See appended Table 43 | P |
| 10.6 | MST 05 – Durability of markings.....: | See appended Table 44 | P |
| 10.7 | MST 06 – Sharp edge test.....: | See appended Table 45 | P |
| 10.8 | MST 07 – Bypass diode functionality test.....: | See appended Table 46 | P |
| 10.22 | MST 33a – General screw connections test.....: | See appended Table 47 | P |
| 10.22 | MST 33b – Locking Screw connections test.....: | See appended Table 48 | P |
| 10.5 | MST 04 – Insulation thickness test.....: | See appended Table 49 | N |
| Supplementary information: | | | |

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|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

Table 5: Overview of MST items for each test sample

| MST item | Sample No. | | | | | | | | | |
|---|------------|---|---|---|---|---|---|---|---|----|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Control module | X | | | | | | | | | |
| MST 01 – Visual inspection | X | | | | | | | | | |
| MST 02 – Performance at STC | X | | | | | | | | | |
| MST 03 – Maximum power determination | X | | | | | | | | | |
| MST 04 – Insulation thickness test | | | | | | | | | | |
| MST 05 – Durability of markings | X | | | | | | | | | |
| MST 06 – Sharp edge test | X | | | | | | | | | |
| MST 11 – Accessibility test | | | | | | | | | | |
| MST 12 – Cut susceptibility test | | | | | | | | | | |
| MST 13 – Continuity test of equipotential bonding | | | | | | | | | | |
| MST 14 – Impulse voltage test | | | | | | | | | | |
| MST 16 – Insulation test | X | | | | | | | | | |
| MST 17 – Wet leakage current test | | | | | | | | | | |
| MST 21 – Temperature Test | X | | | | | | | | | |
| MST 22 – Hot-spot endurance Test | X | | | | | | | | | |
| MST 23 – Fire Test | | | | | | | | | | |
| MST 24 – Ignitability test | X | | | | | | | | | |
| MST 25 – Bypass diode thermal test | X | | | | | | | | | |
| MST 26 – Reverse current overload test | | | | | | | | | | |
| MST 32 – Module breakage test | X | | | | | | | | | |
| MST 33 – Screw connections test | X | | | | | | | | | |
| MST 34 – Static mechanical load test | X | | | | | | | | | |
| MST 35 – Peel test | X | | | | | | | | | |
| MST 36 – Lap shear strength test: | | | | | | | | | | |
| MST 37 – Materials creep test: | X | | | | | | | | | |
| MST 42 – Robustness of terminations test | X | | | | | | | | | |
| MST 51 – Thermal cycling test 50 | X | | | | | | | | | |
| MST 51 - Thermal cycling test 200 | X | | | | | | | | | |
| MST 52 – Humidity freeze test | X | | | | | | | | | |
| MST 53 – Damp heat test 200 h | X | | | | | | | | | |
| MST 53 – Damp heat test 1000 h | X | | | | | | | | | |
| MST 54 – UV test 15 KW/h/m ² | X | | | | | | | | | |
| MST 54 – UV test 60 KW/h/m ² | X | | | | | | | | | |
| MST 55 – Cold conditioning | X | | | | | | | | | |
| MST 56 – Dry heat conditioning | X | | | | | | | | | |

Legend:

X..... Test performed,

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|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

Table 6: MST 01 - Initial Visual inspection

| | | | |
|------------------------------|---|-----------------------------|---|
| Test Date (YYYY-MM-DD).....: | | | — |
| Sample # 1 | Findings.....: | Yes No | P |
| | Nature and position of findings – comments or attach photos | See the Photo Documentation | — |
| Sample #2 | Findings.....: | Yes No | P |
| | Nature and position of findings – comments or attach photos | See the Photo Documentation | — |
| Sample # 3 | Findings.....: | Yes No | P |
| | Nature and position of findings – comments or attach photos | See the Photo Documentation | — |
| Sample # 4 | Findings.....: | Yes No | P |
| | Nature and position of findings – comments or attach photos | See the Photo Documentation | — |
| Sample # 5 | Findings.....: | Yes No | P |
| | Nature and position of findings – comments or attach photos | See the Photo Documentation | — |
| Sample # 6 | Findings.....: | Yes No | P |
| | Nature and position of findings – comments or attach photos | See the Photo Documentation | — |
| Sample # 7 | Findings.....: | Yes No | P |
| | Nature and position of findings – comments or attach photos | See the Photo Documentation | — |
| Sample # 8 | Findings.....: | Yes No | P |
| | Nature and position of findings – comments or attach photos | See the Photo Documentation | — |
| Sample # 9 | Findings.....: | Yes No | P |
| | Nature and position of findings – comments or attach photos | See the Photo Documentation | — |
| Sample # 10 | Findings.....: | Yes No | P |
| | Nature and position of findings – comments or attach photos | See the Photo Documentation | — |

Supplementary information: For creepage distances and clearances see Table 1, Table 2, Table 3 and Table 4

Table 7: MST 02 - Performance at STC

| | | |
|-----------------------------|----------|---|
| Sample..... | Sample 1 | — |
| Test Date [YYYY-MM-DD]..... | | — |
| Irradiance (W/m2) | 1000 | — |

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|--|--------------------|-----------|---------|------------------|-----------------|---------|
| Clause | Requirement + Test | | | | Result - Remark | Verdict |
| Module temperature (°C) | | 25 | | | | — |
| Test method..... | | Simulator | | Natural sunlight | | — |
| Rated Isc including manufacturing tolerances. | | | | | | — |
| Rated Voc including manufacturing tolerances | | | | | | — |
| Isc [A] | Voc [V] | Imp [A] | Vmp [V] | Pmp [W] | FF [%] | Result |
| 6.72 | 42.8 | 6.3 | 36.3 | 230 | 75.76 | P |
| Supplementary information: | | | | | | |

| Table 8: MST 03 - Maximum power determination | | | | | | | | |
|---|---------|-----------|---------|---------|------------------|--------|--------|---|
| Test Date [YYYY-MM-DD] | | | | | | | — | |
| Irradiance (W/m2) | | 1000 | | | | | — | |
| Module temperature (°C) | | 25 | | | | | — | |
| Test method..... | | Simulator | | | Natural sunlight | | | — |
| Sample # | Voc [V] | Isc [A] | Pmp [W] | Vmp [V] | Imp [A] | FF [%] | Result | |
| Sample 1 | 38.53 | 14.06 | 425 | 31.91 | 13.32 | 74.25 | P | |
| Supplementary information: | | | | | | | | |

| Table 9: MST 16 - Initial Insulation test | | | | | | |
|---|----------|----------|----------------------|----|--|--------|
| Test Date (YYYY-MM-DD) | | | | | | — |
| Test Voltage applied (V, DC) | | | | | | — |
| Sample # | Measured | Required | Dielectric breakdown | | | Result |
| | MΩ | MΩ | Yes (description) | No | | |
| Sample 1 | >5000 | 5000 | — | No | | P |
| Supplementary information: Size of module [m ²] | | | | | | |

| Table 10: MST 17 - Initial Wet leakage current test | | | | | | |
|---|---------------|-------------------------|---------------|--|--------|---|
| Test Date (YYYY-MM-DD) | | | | | | — |
| Test Voltage applied (V, dc) | | | | | | — |
| Solution resistivity (Ω cm) | | < 3500 Ω cm at 22 ± 2°C | | | | — |
| Solution temperature (°C) | | | | | | — |
| Sample # | Measured (MΩ) | | Required (MΩ) | | Result | |
| — | — | | — | | — | |
| Supplementary information: Size of module [m ²] | | | | | | |

| Table 11: MST 13 - Continuity test of equipotential bonding | | |
|---|--|---|
| Test Date Initial examination (YYYY-MM-DD) | | — |

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|--|----------------------------|-----------------|----------------|---------|
| Clause | Requirement + Test | Result - Remark | | Verdict |
| Test Date Final examination (YYYY-MM-DD) | | | | — |
| Maximum over-current protection rating (A) . | | | | — |
| Current applied (A) | | | | — |
| Location of designated grounding point..... | | | | — |
| Location of second contacting point | | | | — |
| Sample # | Position in test sequence: | Voltage [V] | Resistance [Ω] | |

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|----------------------------|---|-----------------|---|---------|
| Clause | Requirement + Test | Result - Remark | | Verdict |
| 1 | Initial examination | — | — | — |
| | Preconditioning: MST 54, MST 51, MST 52, MST 42, MST 12 | — | — | — |
| | Final examination | — | — | — |
| 2 | Initial examination | — | — | — |
| | Preconditioning: MST 51, MST 12 | — | — | — |
| | Final examination | — | — | — |
| 3 | Initial examination | — | — | — |
| | Preconditioning: MST 53, MST 34, MST 12 | — | — | — |
| | Final examination | — | — | — |
| 4 | Initial examination | — | — | — |
| | Preconditioning: MST 37 | — | — | — |
| | Final examination | — | — | — |
| 5 | Initial examination | — | — | — |
| | Preconditioning: MST 53, MST 54, MST 52, MST 54, MST 52, MST 12 | — | — | — |
| | Final examination | — | — | — |
| 6 | Initial examination | — | — | — |
| | Preconditioning: MST 55, MST 56, MST 52, MST 55, MST 52, MST12 | — | — | — |
| | Final examination | — | — | — |
| 7 | Initial examination | — | — | — |
| | Preconditioning: MST 32 | — | — | — |
| | Final examination | — | — | — |
| Supplementary information: | | | | |

| Table 12: MST 11 - Accessibility test | | | | |
|---|---|-----|----|---|
| Test Date Initial examination (YYYY-MM-DD) | | | | — |
| Test Date Final examination (YYYY-MM-DD) | | | | — |
| Sample # | Position in test sequence: | | | |
| 1 | Initial examination, access? | Yes | No | — |
| | Preconditioning: MST 54, MST 51, MST 52, MST 42, MST 12, MST 13 | | | — |
| | Final examination, access? | Yes | No | — |
| 2 | Initial examination, access? | Yes | No | — |

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|----------------------------|---|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| | Preconditioning: MST 51, MST 12, MST 13 | | — |
| | Final examination, access? | Yes No | — |
| 3 | Initial examination, access? | Yes No | — |
| | Preconditioning: MST 53, MST 34, MST 12, MST 13 | | — |
| | Final examination, access? | Yes No | — |
| 4 | Initial examination, access? | Yes No | — |
| | Preconditioning: MST 37, MST 13 | | — |
| | Final examination, access? | Yes No | — |
| 5 | Initial examination, access? | Yes No | — |
| | Preconditioning: MST 53, MST 54, MST 52, MST 54, MST 52, MST 12, MST 13 | | — |
| | Final examination, access? | Yes No | — |
| 6 | Initial examination, access? | Yes No | — |
| | Preconditioning: MST 55, MST 56, MST 52, MST 55, MST 52, MST12 | | — |
| | Final examination, access? | Yes No | — |
| Supplementary information: | | | |

| SEQUENCE A | | | | | |
|---|---|-----------|----|----------------------|--------|
| Sample # | 2 | | | | — |
| Table 13: MST 37 - Materials creep test | | | | | |
| Test Date (YYYY-MM-DD) start/end | | | | | — |
| Duration [h]..... 200 | | | | | — |
| Applied temperature [°C] | | | | | — |
| MST 01: Visual inspection after materials creep test | | | | | |
| Test Date (YYYY-MM-DD)..... | | | | | — |
| Findings..... | | Yes | No | | P |
| Nature and position of findings – comments or attach photos | | | | | — |
| Supplementary information: For clearance and creepage distances see table XYZ | | | | | |
| MST 16: Insulation test after materials creep test | | | | | |
| Test Date (YYYY-MM-DD)..... | | | | | — |
| Test Voltage applied (V, dc) | | 20 | | | — |
| Measured | | Required | | Dielectric breakdown | Result |
| MΩ | | MΩ | | Yes (description) | No |
| >5000 | | 5000 | | --- | No P |

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|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

| MST 17: Wet leakage current test after materials creep test | | | — |
|--|-------------------------|--|--------|
| Test Date (YYYY-MM-DD) | | | — |
| Test Voltage applied (V, dc) | | | — |
| Solution resistivity (Ω cm) | < 3500 Ω cm at 22 ± 2°C | | — |
| Solution temperature (°C) | | | — |
| Measured(MΩ) | Required (MΩ) | | Result |
| — | — | | — |
| Supplementary information: | | | |

| SEQUENCE B | | | |
|---|-----------|----------------------|----|
| Sample # | 3 | | — |
| Table 14: MST 53 - Damp heat test | | | |
| Test Date (YYYY-MM-DD) start/end | | | — |
| Duration [h] | 200 | | — |
| MST 01: Visual inspection after Damp heat test | | | |
| Test Date (YYYY-MM-DD) | | | — |
| Findings | Yes | No | P |
| Nature and position of findings – comments or attach photos | | | — |
| MST 16: Insulation test after Damp heat test | | | |
| Test Date (YYYY-MM-DD) | | | — |
| Test Voltage applied (V, DC) | 20 | | — |
| Measured | Required | Dielectric breakdown | |
| MΩ | MΩ | Yes (description) | No |
| >5000 | 5000 | --- | No |
| Result | | | |
| | | | P |
| Supplementary information: | | | |

| Table 15: MST 54 - UV test | | | |
|--|-----------|----|---|
| Test Date (YYYY-MM-DD) start/end | | | — |
| Module temperature [°C] | 60 | | — |
| Irradiation total [kWh/ m ²] | 60 | | — |
| Open circuits | Yes | No | P |
| MST 01: Visual inspection after UV test | | | |
| Test Date (YYYY-MM-DD) | | | — |
| Findings | Yes | No | P |
| Nature and position of findings – comments | | | — |

| EN IEC 61730-2 | | | |
|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

| or attach photos | | | | |
|--|----------|----------------------|----|--------|
| MST 16: Insulation test after UV test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, DC) | | 20 | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| Supplementary information: -- | | | | |

| Table 16: MST 52 -Humidity freeze test | | | | |
|---|----------|----------------------|----|--------|
| Test Date (YYYY-MM-DD) start/end | | | | — |
| Total cycles (10) | | 10 | | — |
| Open circuits | | Yes..... | No | P |
| MST 01: Visual inspection after Humidity freeze test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Findings | | Yes..... | No | P |
| Nature and position of findings – comments or attach photos | | | | — |
| MST 16: Insulation test after Humidity freeze test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, DC) | | 20 | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| Supplementary information: | | | | |

| Table 17: MST 54 - UV test | | | | |
|---|--|----------|----|---|
| Test Date (YYYY-MM-DD) start/end | | | | — |
| Module temperature [°C] | | 60 | | — |
| Irradiation total [kWh/m²] | | 60 | | — |
| Open circuits | | Yes..... | No | P |
| MST 01: Visual inspection after UV test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Findings | | Yes..... | No | P |
| Nature and position of findings – comments or attach photos | | | | — |

| EN IEC 61730-2 | | | |
|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

| MST 16: Insulation test after UV test | | | | — |
|--|----------|----------------------|----|--------|
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, DC) | | 20 | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| Supplementary information: | | | | |

| Table 18: MST 52 - Humidity freeze test | | | | |
|---|---------------|-------------------------|--------|--------|
| Test Date (YYYY-MM-DD) start/end..... | | | | — |
| Total cycles (10) | | 10 | | — |
| Open circuits..... | | Yes | No | |
| MST 01: Visual inspection after Humidity freeze test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Findings | | Yes | No | P |
| Nature and position of findings – comments or attach photos | | | | — |
| MST 16: Insulation test after Humidity freeze test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, DC) | | 20 | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| MST 17: Wet leakage current test after humidity freeze 10 test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, dc) 20 | | | | — |
| Solution resistivity (Ω cm)..... | | < 3500 Ω cm at 22 ± 2°C | | — |
| Solution temperature (°C)..... | | | | — |
| Measured (MΩ) | Required (MΩ) | | Result | |
| — | — | | — | |
| Supplementary information: | | | | |

| SEQUENCE B1 | | | | |
|---|---|--|--|---|
| Sample # | 4 | | | — |
| Table 19: MST 55 - Cold conditioning | | | | |
| Test Date (YYYY-MM-DD) start/end..... | | | | — |

| EN IEC 61730-2 | | | | |
|---|--------------------|----------------------|---------|--------|
| Clause | Requirement + Test | Result - Remark | Verdict | |
| Temperature [°C] Duration [h] | | -40 / 48 | — | |
| MST 01: Visual inspection after Cold conditioning | | | — | |
| Test Date (YYYY-MM-DD) | | | — | |
| Findings | | Yes..... No | P | |
| Nature and position of findings – comments or attach photos | | | — | |
| MST 16: Insulation test after Cold conditioning | | | — | |
| Test Date (YYYY-MM-DD) | | | — | |
| Test Voltage applied (V, DC) | | 20 | — | |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| Supplementary information: -- | | | | |

| Table 20: MST 56 - Dry heat conditioning | | | | |
|--|----------|----------------------|----|--------|
| Test Date (YYYY-MM-DD) start/end..... | | | — | |
| Temperature [°C] Duration [h] | | 90 / 200 | — | |
| MST 01: Visual inspection after Dry heat conditioning | | | — | |
| Test Date (YYYY-MM-DD) | | | — | |
| Findings | | Yes..... No | P | |
| Nature and position of findings – comments or attach photos | | | — | |
| MST 16: Insulation test after Dry heat conditioning | | | — | |
| Test Date (YYYY-MM-DD) | | | — | |
| Test Voltage applied (V, DC) | | 20 | — | |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| Supplementary information: | | | | |

| Table 21: MST 52 - Humidity freeze test | | | |
|---|--|-------------|---|
| Test Date (YYYY-MM-DD) start/end..... | | | — |
| Total cycles (10)..... | | 10 | — |
| Open circuits | | Yes..... No | P |
| MST 01: Visual inspection after Humidity freeze test | | | — |
| Test Date (YYYY-MM-DD) | | | — |

| EN IEC 61730-2 | | | |
|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

| | | | | |
|---|----------|----------------------|----|--------|
| Findings | Yes..... | No | P | |
| Nature and position of findings – comments or attach photos | | | — | |
| MST 16: Insulation test after Humidity freeze test | | | — | |
| Test Date (YYYY-MM-DD) | | | — | |
| Test Voltage applied (V, DC) | 20 | | — | |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| Supplementary information: | | | | |

| | | | | |
|---|-----------|----------------------|----|--------|
| Table 22: MST 55 - Cold conditioning | | | | |
| Test Date (YYYY-MM-DD) start/end..... | | | — | |
| Temperature [°C] / Duration [h] | - 40 / 48 | | — | |
| MST 01: Visual inspection after Cold conditioning | | | — | |
| Test Date (YYYY-MM-DD) | | | — | |
| Findings | Yes..... | No | P | |
| Nature and position of findings – comments or attach photos | | | — | |
| MST 16: Insulation test after Cold conditioning | | | — | |
| Test Date (YYYY-MM-DD) | | | — | |
| Test Voltage applied (V, DC) 20 | | | — | |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| Supplementary information: | | | | |

| | | | |
|---|----------|----|---|
| Table 23: MST 52 - Humidity freeze test | | | |
| Test Date (YYYY-MM-DD) start/end..... | | | — |
| Total cycles (10)..... | 10 | | — |
| Open circuits..... | Yes..... | No | P |
| MST 01: Visual inspection after Humidity freeze test | | | — |
| Test Date (YYYY-MM-DD) | | | — |
| Findings | | | P |
| Nature and position of findings – comments or attach photos | | | — |

| EN IEC 61730-2 | | | |
|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

| Test Date (YYYY-MM-DD) | | | | — |
|--|----------|-------------------------|----|--------|
| Test Voltage applied (V, DC) 20 | | | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| MST 17: Wet leakage current test after humidity freeze test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, dc) | | | | — |
| Solution resistivity (Ω cm) | | < 3500 Ω cm at 22 ± 2°C | | — |
| Solution temperature (°C) | | | | — |
| Measured [MΩ] | | Required [MΩ] | | Result |
| — | | — | | — |
| Supplementary information: | | | | |

| SEQUENCE C | | | | |
|---|-----------|----------------------|----|--------|
| Sample # | 5 | | | — |
| Table 24: MST 54 - UV test | | | | |
| Test Date (YYYY-MM-DD) start/end | | | | — |
| Module temperature [°C] | 60 | | | — |
| Irradiation total [kWh/m ²] | 15 | | | — |
| Open circuits | Yes | No | | P |
| MST 01: Visual inspection after UV test | | | | |
| Test Date (YYYY-MM-DD) | | | | — |
| Findings | | | | P |
| Nature and position of findings – comments or attach photos | | | | — |
| MST 16: Insulation test after UV test | | | | |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, DC) | | 20 | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| Supplementary information: | | | | |

| EN IEC 61730-2 | | | |
|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

| Table 25: MST 51 - Thermal cycling test | | | | |
|---|----------|----------------------|----|--------|
| Test Date (YYYY-MM-DD) start/end..... | | | | — |
| Total cycles (50) | | 50 | | — |
| Applied current (A) | | | | — |
| Limiting voltage (V) | | | | — |
| Open circuits..... | | Yes..... | No | P |
| MST 01: Visual inspection after Thermal cycling test | | | | |
| Test Date (YYYY-MM-DD) | | | | — |
| Findings | | Yes..... | No | P |
| Nature and position of findings – comments or attach photos | | | | — |
| MST 16: Insulation test after Thermal cycling test | | | | |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, DC) | | 20 | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| Supplementary information: -- | | | | |

| Table 26: MST 52 - Humidity freeze test | | | | |
|---|----------|----------------------|----|--------|
| Test Date (YYYY-MM-DD) start/end..... | | | | — |
| Total cycles (10)..... | | 10 | | — |
| Open circuits..... | | Yes..... | No | P |
| MST 01: Visual inspection after Humidity freeze test | | | | |
| Test Date (YYYY-MM-DD) | | | | — |
| Findings | | Yes..... | No | P |
| Nature and position of findings – comments or attach photos | | | | — |
| MST 16: Insulation test after Humidity freeze test | | | | |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, DC) 20 | | | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | NO | |
| >5000 | 5000 | --- | NO | P |
| MST 17: Wet leakage current test after humidity freeze test | | | | |
| Test Date (YYYY-MM-DD) | | | | — |

| EN IEC 61730-2 | | | |
|--|--------------------|------------------------|------------------------------------|
| Clause | Requirement + Test | Result - Remark | Verdict |
| Test Voltage applied (V, dc) | | | — |
| Solution resistivity (Ω cm) | | | < 3500 Ω cm at 22 \pm 2°C |
| Solution temperature ($^{\circ}$ C) | | | — |
| Measured (M Ω) | | Required (M Ω) | Result |
| — | | — | — |
| Supplementary information: | | | |

Table 27: MST 42 - Robustness of terminations test

| | | |
|------------------------------|--|---|
| Test Date (YYYY-MM-DD) | | — |
|------------------------------|--|---|

MQT 14.1: Retention of junction box on mounting surface

Supplementary information:

MST 01: Visual inspection after retention of junction box on mounting surface

| | | |
|------------------------------|--|---|
| Test Date (YYYY-MM-DD) | | — |
|------------------------------|--|---|

| | | | |
|----------------|-----------|----|---|
| Findings | Yes | No | P |
|----------------|-----------|----|---|

| | | |
|---|--|---|
| Nature and position of findings – comments or attach photos | | — |
|---|--|---|

MST 17: Wet leakage current test after retention of junction box on mounting surface

| | | |
|------------------------------|--|---|
| Test Date (YYYY-MM-DD) | | — |
|------------------------------|--|---|

| | | |
|--------------------------------|--|---|
| Test Voltage applied [V] | | — |
|--------------------------------|--|---|

| | | |
|---|------------------------------------|---|
| Solution resistivity (Ω cm) | < 3500 Ω cm at 22 \pm 2°C | — |
|---|------------------------------------|---|

| | | |
|--|--|---|
| Solution temperature ($^{\circ}$ C) | | — |
|--|--|---|

| | | |
|------------------------|------------------------|--------|
| Measured [M Ω] | Required [M Ω] | Result |
|------------------------|------------------------|--------|

| | | |
|---|---|---|
| — | — | — |
|---|---|---|

Supplementary information:

SEQUENCE D

| | | |
|----------|---|---|
| Sample # | 6 | — |
|----------|---|---|

Table 28: MST 53 - Damp heat test

| | | |
|--|--|---|
| Test Date (YYYY-MM-DD) start/end | | — |
|--|--|---|

| | | |
|--------------------------|------|---|
| Total hours (1000) | 1000 | — |
|--------------------------|------|---|

MST 01: Visual inspection after damp heat test

| | | |
|------------------------------|--|---|
| Test Date (YYYY-MM-DD) | | — |
|------------------------------|--|---|

| | | | |
|----------------|-----------|----|---|
| Findings | Yes | No | P |
|----------------|-----------|----|---|

| | | |
|---|--|---|
| Nature and position of findings – comments or attach photos | | — |
|---|--|---|

| EN IEC 61730-2 | | | |
|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

| MST 16: Insulation test after damp heat test | | | | — |
|--|----------|-------------------------|----|--------|
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, DC) | | | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| MST 17: Wet leakage current test after damp heat test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, dc) | | | | — |
| Solution resistivity (Ω cm) | | < 3500 Ω cm at 22 ± 2°C | | — |
| Solution temperature (°C) | | | | — |
| Measured (MΩ) | | Required (MΩ) | | Result |
| — | | — | | — |
| Supplementary information: | | | | |

| Table 29: MST 34 - Static mechanical load test | | | | |
|--|------------|-----------|--|---|
| Test Date (YYYY-MM-DD) | | | | — |
| Mounting method | | | | — |
| Design Load [Pa] / Safety factor γ _m | | | | — |
| Load applied to | front side | back side | | — |
| Mechanical load [Pa] | | | | — |
| First cycle time (start/end) | 1h | 1h | | — |
| Intermittent open-circuit (yes/no) | No | No | | P |
| Second cycle time (start/end) | 1h | 1h | | — |
| Intermittent open-circuit (yes/no) | No | No | | P |
| Third cycle time (start/end) | 1h | 1h | | — |
| Intermittent open-circuit (yes/no) | No | No | | P |
| Supplementary information: Maximum bending at module centre xx mm. | | | | |
| MST 01: Visual inspection after Static mechanical load test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Findings | Yes | No | | P |
| Nature and position of findings – comments or attach photos | | | | — |
| MST 16: Insulation test after Static mechanical load test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, DC) | | 30 | | — |

| EN IEC 61730-2 | | | |
|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

| Measured | Required | Dielectric breakdown | | Result |
|---|----------|----------------------|----|--------|
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |
| MST 17: Wet leakage current test after Static mechanical load test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, dc) | | | | — |
| Solution resistivity (Ω cm) < 3500 Ω cm at 22 ± 2°C | | | | — |
| Solution temperature (°C) | | | | — |
| Measured (MΩ) | | Required (MΩ) | | Result |
| — | | — | | — |
| Supplementary information: | | | | |

SEQUENCE E

| | | |
|----------|---|---|
| Sample # | 7 | — |
|----------|---|---|

Table 30: MST 51 - Thermal cycling test

| | | |
|---------------------------------------|--------------|---|
| Test Date (YYYY-MM-DD) start/end..... | | — |
| Total cycles (200) 200 | | — |
| Applied current (A) | | — |
| Limiting voltage (V) | | — |
| Open circuits..... | Yes No | |

MST 01: Visual inspection after Thermal cycling test

| | | |
|---|--------------|---|
| Test Date (YYYY-MM-DD) | | — |
| Findings | Yes No | |
| Nature and position of findings – comments or attach photos | | — |

MST 16: Insulation test after Thermal cycling test

| Test Date (YYYY-MM-DD) | | — | | |
|------------------------------------|----------|----------------------|----|--------|
| Test Voltage applied (V, DC) | | — | | |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | --- | No | P |

MST 17: Wet leakage current test after Thermal cycling test

| | | |
|------------------------------------|-------------------------|---|
| Test Date (YYYY-MM-DD) | | — |
| Test Voltage applied (V, dc) | | — |
| Solution resistivity (Ω cm)..... | < 3500 Ω cm at 22 ± 2°C | — |
| Solution temperature (°C)..... | | — |

| EN IEC 61730-2 | | | |
|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

| Measured (MΩ) | Required (MΩ) | Result |
|----------------------------|---------------|--------|
| — | — | — |
| Supplementary information: | | |

SEQUENCE F

| | | |
|----------|---|---|
| Sample # | 8 | — |
|----------|---|---|

Table 31: MST 25 - Bypass diode thermal test

| | | |
|--|---------|---|
| Test Date [YYYY-MM-DD] start/end..... | | — |
| Module temperature [°C]..... | 90±5 | — |
| Number of diodes in junction box..... | 3 | — |
| Diode manufacturer..... | | — |
| Diode type designation..... | 30SQ045 | — |
| Max. permissible junction temperature Tmax [°C] (according to diode datasheet) | | — |

Step 1, Determination of VD versus TJ characteristic

| | | | | | |
|---|--------|--------|--------|--------|---|
| Ambient temperature of the junction box [°C]... | 30 ± 2 | 50 ± 2 | 70 ± 2 | 90 ± 2 | — |
| Pulsed current..... | 12 | 12 | 12 | 12 | P |
| Voltage drop [V]..... | 0.65 | 0.68 | 0.63 | 0.60 | P |
| VD versus TJ characteristic | | | | | |
| Max. permissible junction temperature Tjmax [°C] (according to diode datasheet) | | | | | |

Step 2, Bypass diode thermal test

| | Diode 1 | Diode 2 | Diode 3 | Result |
|--|---------|---------|---------|--------|
| Current flow applied [A] | 12 | 12 | 12 | P |
| Max. diode surface temperature allowed Tjmax [°C], | 136 | 133 | 135 | P |
| Voltage drop [V] after 1h | 0.57 | 0.56 | 0.57 | P |
| Calculated max. junction temperature Tjcalc [°C] | 107 | 106 | 109 | P |
| Tjcalc < Tjmax (test passed)? yes/no | yes | yes | yes | P |
| Current flow (1.25 * Isc) [A] | 15 | 15 | 15 | P |
| Bypass diode remain(s) functional (yes/no) | yes | yes | yes | P |

Remarks: See Table 46 for the test details of bypass diode functionality test

MST 01: Visual inspection after Bypass diode thermal test

| | | |
|--|---|---|
| Test Date [YYYY-MM-DD] | | — |
| Findings..... | <input type="checkbox"/> Yes..... <input type="checkbox"/> No | |
| Nature and position of findings – comments | | P |

| EN IEC 61730-2 | | | | |
|---|--------------------|-------------------------|-----------------|---------|
| Clause | Requirement + Test | | Result - Remark | Verdict |
| MST 16: Insulation test after Bypass diode thermal test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, DC) | | 1500 | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | | Yes (description) | No | |
| ≥40 | 57 | | No | P |
| MST 17: Wet leakage current test after Bypass diode thermal test | | | | — |
| Test Date [YYYY-MM-DD]: | | | | — |
| Test Voltage applied [V]: | | 1000 | | — |
| Solution resistivity [Ω cm] | | < 3500 Ω cm at 22 ± 2°C | | — |
| Solution temperature [°C] | | | | — |
| Measured [MΩ] | | Required [MΩ] | | Result |
| ≥40 | | 58 | | P |
| Supplementary information: | | | | |

| Table 32: MST 21 - Temperature Test | | | | |
|---|--|---|-------------------------------------|---|
| Reference solar irradiance (W/m ²) | 1000 W/m ² | | | — |
| Reference ambient temperature (°C) | 30.4°C | | | — |
| Module at MPP | | | | |
| Measuring location: | Component temperature T _{OBS} (°C) | Normalized temperature T _{CON} (°C) | Component temperature limit (°C) | — |
| Terminal enclosure interior surface | 67.9 | 78.6 | 85 | P |
| Field wiring terminals | 63.8 | 66.7 | 85 | P |
| PV module frontsheet above the centre cell | 64.2 | 67.5 | 85 | P |
| PV module backsheet below the centre cell | 67.5 | 68.4 | 85 | P |
| Insulation of the field wiring leads | 62.1 | 63.5 | 90 | P |
| External connector bodies | 58.6 | 60.4 | 90 | P |
| Bypass diode bodies | | | | N |
| Frame | | | | N |
| MST 01: Visual inspection after Temperature Test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Findings | Yes | | No | P |
| Nature and position of findings – comments or attach photos | | | | — |

| EN IEC 61730-2 | | | |
|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

| | | | |
|--|----------|-------------------------|----|
| Test Date (YYYY-MM-DD) | | | — |
| Test Voltage applied (V, DC)..... | | 50 | — |
| Measured | Required | Dielectric breakdown | |
| MΩ | MΩ | Yes (description) | No |
| >5000 | 5000 | --- | No |
| MST 17: Wet leakage current test after Temperature Test | | | — |
| Test Date (YYYY-MM-DD) | | | — |
| Test Voltage applied (V, dc) | | | — |
| Solution resistivity (Ω cm) | | < 3500 Ω cm at 22 ± 2°C | |
| Solution temperature (°C) | | | — |
| Measured (MΩ) | | Required (MΩ) | |
| — | | — | |
| Supplementary information: | | | |

| | | | | | |
|--|---------|------------------------------|-----------------------------|-----------------------------|--------|
| Table 33: MST 22 - Hot-spot endurance test | | | | | |
| Test Date (YYYY-MM-DD) start/end..... | | | | | — |
| Cell interconnection circuit..... | | <input type="checkbox"/> S | <input type="checkbox"/> SP | <input type="checkbox"/> PS | — |
| Irradiance during each cycle..... | | | | | — |
| Module temperature at thermal equilibrium in each cycle [°C] | | | | | — |
| Determination of worst case cell | | | | | |
| Maximum measured cell temperature in each cycle [°C]..... | | | | | — |
| Shading rate [%] or number of cells shaded..... | | | | | — |
| Test hours for each cycle | | | | | — |
| MST 01: Visual inspection after hot-spot endurance test | | | | | |
| Test Date (YYYY-MM-DD) | | | | | — |
| Findings | | <input type="checkbox"/> Yes | <input type="checkbox"/> No | | P |
| Nature and position of findings – comments or attach photos | | | | | — |
| MST 02: Maximum power determination after hot-spot endurance test | | | | | |
| Test Date [YYYY-MM-DD]..... | | | | | — |
| Module temperature [°C] | | 25°C | | | — |
| Irradiance [W/m²] 1000 | | | | | — |
| Voc [V] | Isc [A] | Pmp [W] | Vmp [V] | Imp [A] | FF [%] |
| 38.35 | 14.08 | 425 | 31.91 | 13.32 | 78.72 |

| MST 16: Insulation test after hot-spot endurance test | | | | — |
|--|----------|-------------------------|----|--------|
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied [V] | | | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| >5000 | 5000 | — | No | P |
| MST 17: Wet leakage current test after hot-spot endurance test | | | | — |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied [V] | | | | — |
| Solution resistivity [Ω cm] | | < 3500 Ω cm at 22 ± 2°C | | — |
| Solution temperature [°C] | | | | — |
| Measured [MΩ] | | Required [MΩ] | | Result |
| — | | — | | — |
| Supplementary information: | | | | |

| Table 34: MST 26 - Reverse current overload test | | | | |
|---|----------|--|----|--------|
| Test Date (YYYY-MM-DD).....: | | | | — |
| Module over-current protection rating (A)....: | | | | — |
| Test current (A).....: | | | | — |
| Range of applied voltage (V).....: | | | | — |
| Test duration.....: | | 2 hours | | — |
| Observations | | | | Result |
| <input type="checkbox"/> No flaming of the module | | | | |
| <input type="checkbox"/> No flaming or charring of the cheesecloth | | | | |
| <input type="checkbox"/> No flaming of the tissue paper | | | | |
| <input type="checkbox"/> MST 17 requirements fulfilled (see appended Table MST17) | | | | |
| Supplementary information: Max. measured temperature: xx°C | | | | |
| MST 01: Visual inspection after Reverse current overload test | | | | — |
| Test Date (YYYY-MM-DD) : | | | | — |
| Findings : | | <input type="checkbox"/> Yes <input type="checkbox"/> No | | — |
| Nature and position of findings – comments or attach photos | | | | — |
| MST 16: Insulation test after Reverse current overload test | | | | — |
| Test Date (YYYY-MM-DD) : | | | | — |
| Test Voltage applied (V, DC) : | | | | — |
| Measured | Required | Dielectric breakdown | | Result |
| MΩ | MΩ | Yes (description) | No | |
| | | | | |

| | | |
|---|------------------------------------|--------|
| MST 17: Wet leakage current test after Reverse current overload test | | — |
| Test Date (YYYY-MM-DD) : | | — |
| Test Voltage applied (V, dc) : | | — |
| Solution resistivity (Ω cm) : | < 3500 Ω cm at 22 \pm 2°C | — |
| Solution temperature (°C) : | 23 | — |
| Measured (M Ω) | Required (M Ω) | Result |
| Supplementary information: | | |

| SEQUENCE G | | | | |
|---|--|----------------------|----|--------|
| Sample #: | 16 | | | — |
| Table 35: MST 14 - Impulse voltage test | | | | |
| Test Date (YYYY-MM-DD) | | | | — |
| Maximum system voltage (V) | | | | — |
| Required Impulse voltage (V) | | | | — |
| Measured Impulse voltage (V) | | | | |
| T ₁ (μ s) | | | | |
| T ₂ (μ s) | | | | |
| Thickness of conductive foil (mm) | | | | — |
| Results | | | | |
| <input type="checkbox"/> No evidence of dielectric breakdown or surface tracking observed | | | | |
| <input type="checkbox"/> No evidence of major visual defects (see table MST 01 below) | | | | |
| MST 01: Visual inspection after Impulse voltage test | | | | |
| Test Date (YYYY-MM-DD) | | | | — |
| Findings | <input type="checkbox"/> Yes <input type="checkbox"/> No | | | |
| Nature and position of findings – comments or attach photos | | | | — |
| MST 16: Insulation test after Impulse voltage test | | | | |
| Test Date (YYYY-MM-DD) | | | | — |
| Test Voltage applied (V, DC) | | | | — |
| Measured | Required | Dielectric breakdown | | Result |
| M Ω | M Ω | Yes (description) | No | |
| | | | | |
| Supplementary information: | | | | |

| OTHER TESTS | | |
|--|--|---|
| Sample #: | | — |
| Table 36: MST 23 - Fire test | | |
| Test Date (YYYY-MM-DD)..... | | — |
| Module fire resistance class (A, B, C)..... | | — |
| No. of modules provided to create the test assembly | | — |
| <input type="checkbox"/> The module complies with the requirements for the fire resistance class | | — |
| Supplementary information: | | |

| | | |
|---|--|---|
| Sample #: 1 | | P |
| Table 37: MST 24 - Ignitability test | | |
| Test Date (YYYY-MM-DD)..... | | — |
| Flame application point..... | 50mm above the bottom edge of the sample | P |
| Surface exposure..... | <input type="checkbox"/> Yes <input type="checkbox"/> No | P |
| Backsheet foil exposure..... | <input type="checkbox"/> Yes <input type="checkbox"/> No | P |
| Frame adhesive exposure..... | <input type="checkbox"/> Yes <input type="checkbox"/> No | P |
| Edge exposure..... | <input type="checkbox"/> Yes <input type="checkbox"/> No | P |
| Junction box adhesive exposure..... | <input type="checkbox"/> Yes <input type="checkbox"/> No | P |
| Type label exposure..... | <input type="checkbox"/> Yes <input type="checkbox"/> No | P |
| Backrail adhesive exposure..... | <input type="checkbox"/> Yes <input type="checkbox"/> No | P |
| Ignition occurs..... | <input type="checkbox"/> Yes <input type="checkbox"/> No | P |
| Flame spread less as 150 mm | <input type="checkbox"/> Yes <input type="checkbox"/> No | P |
| Length of destroyed area..... | >1500mm | P |
| Supplementary information: | | |

| | | |
|---|--|--------|
| Sample #: | | |
| Table 38: MST 32 - Module breakage test | | |
| Test Date (YYYY-MM-DD) | | P |
| Weight of impactor (kg) | 5.066 | P |
| Thickness of sample (mm) | >5mm | P |
| Mounting technique used | No breakage | P |
| | No separation from frame or mounting structure | P |
| | Breakage occurred, no shear or opening large enough for a 76 mm diameter sphere to pass freely developed | P |
| | Breakage occurred, no particles larger than 65 cm ² ejected from sample | P |
| | Continuity of equipotential bonding provided, see table 10.11 | N |
| Nature and position of findings – comments or attach photos | | Result |
| | | P |
| Supplementary information: | | |

| | | |
|---|---|---|
| Sample #: | 10 | — |
| Table 39: MST 35 - Peel test (only for cemented joints) | | |
| Test Date (YYYY-MM-DD) | | — |
| Location | Flexible Frontsheet Flexible Backsheet Rigid Frontsheet Rigid Backsheet Other areas | P |
| Width of cemented joint | ≤ 10 mm > 10mm | P |
| Description of area | | — |
| Arithmetic mean M1 of adhesion force of unconditioned samples [N] | 36 | — |
| Arithmetic mean M2 of adhesion force of samples conditioned with sequence B [N] | 68 | — |
| Loss of adhesion force: | | P |
| Supplementary information: | | |

| | | |
|---|--|---|
| Sample #: | | — |
| Table 40: MST 36 - Lap shear strength test (only for cemented joints) | | |
| Test Date (YYYY-MM-DD)..... | | — |
| Preconditioning: | | |
| MST 53 Test Date (YYYY-MM-DD) start/end.... | | — |
| MST 54 Test Date (YYYY-MM-DD) start/end.... | | — |
| MST 52 Test Date (YYYY-MM-DD) start/end.... | | — |
| MST 54 Test Date (YYYY-MM-DD) start/end.... | | — |
| MST 52 Test Date (YYYY-MM-DD) start/end.... | | — |
| Arithmetic mean M1 of adhesion force of unconditioned samples [N] | | — |
| Arithmetic mean M2 of adhesion force of samples conditioned with sequence B [N] | | — |
| Loss of adhesion force: | | — |
| Supplementary information: | | |

| | | | |
|---|---|----------|----|
| Table 41: MST 12 - Cut susceptibility test | | | |
| Test Date (YYYY-MM-DD)..... | : | | — |
| Applied force (N) | : | | — |
| MST 01 Visual inspection after cut test | | | |
| Test Date (YYYY-MM-DD)..... | : | | — |
| Sample # 5 | Findings..... | Yes..... | No |
| | Nature and position of findings – comments or attach photos | | — |
| Sample # 7 | Findings..... | Yes..... | No |
| | Nature and position of findings – comments or attach photos | | — |
| Sample # 9 | Findings..... | Yes..... | No |
| | Nature and position of findings – comments or attach photos | | — |
| Sample # 14 | Findings..... | Yes..... | No |
| | Nature and position of findings – comments or attach photos | | — |
| | Findings..... | Yes..... | No |
| | Nature and position of findings – comments or attach photos | | — |

| MST 16: Insulation test after cut test | | | | | — |
|--|----------|----------|----------------------|----|--------|
| Test Date (YYYY-MM-DD)..... : | | | | | — |
| Test Voltage applied (V, DC) | | | | | — |
| Sample # | Measured | Required | Dielectric breakdown | | Result |
| | MΩ | MΩ | Yes (description) | No | |
| 5 | | 5000 | --- | No | — |
| 7 | | 5000 | --- | No | — |
| 9 | | 5000 | --- | No | — |
| 14 | | 5000 | --- | No | — |
| 15 | | 5000 | --- | No | — |

| MST 17: Wet leakage current test after cut test | | | | — |
|---|---------------|---------------|-------------------------|---|
| Test Date (YYYY-MM-DD)..... | | | | — |
| Test Voltage applied (V, dc)..... | | | | — |
| Solution resistivity (Ω cm) | | | < 3500 Ω cm at 22 ± 2°C | — |
| Solution temperature (°C) | | | | — |
| Sample # | Measured (MΩ) | Required (MΩ) | Result | |
| | | | — | |
| Supplementary information: | | | | |

| Table 42: MST 03 - Maximum power determination final | | | | | | |
|--|---------|---------|---------|---------|---------|--------|
| Test Date (YYYY-MM-DD)..... | | | | | | — |
| Module temperature (°C) | | 25 | | | | — |
| Irradiance (W/m ²)..... | | 1000 | | | | — |
| Sample # | Voc (V) | Isc (A) | Pmp (W) | Vmp (V) | Imp (A) | FF (%) |
| 1 | 38.53 | 14.083 | 425 | 31.91 | 13.32 | 72.38 |
| Supplementary information: | | | | | | |

| EN IEC 61730-2 | | | |
|----------------|--------------------|-----------------|---------|
| Clause | Requirement + Test | Result - Remark | Verdict |

| Table 43: MST 01 - Final Visual inspection | | | |
|--|--|--------------|---|
| Test Date (YYYY-MM-DD) | | | — |
| Sample # 1 | Findings..... | Yes No | P |
| | Nature and position of findings – comments or attach photos | | — |
| | Nature and position of findings – comments or attach photos | | — |
| Supplementary information: | | | |

| Table 44: MST 05 - Durability of markings | | | | | | | |
|---|------------------|----|----------------------|----|------------|--------|---|
| Test Date (YYYY-MM-DD) | | | | — | | | |
| Sample # | Markings legible | | Not easily removable | | No curling | Result | |
| 1 | Yes | No | Yes | No | Yes | No | P |
| Supplementary information: | | | | | | | |

| Table 45: MST 06 - Sharp edge test | | | |
|------------------------------------|---|--|--------|
| Test Date (YYYY-MM-DD) : | | | — |
| Sample # | Accessible surfaces free of sharp edges, burrs etc. | | Result |
| 1 | <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No | | P |
| Supplementary information: | | | |

| Table 46: MST 07 - Bypass diode functionality test | | | | |
|--|-----|----------|--|--------|
| Test Date (YYYY-MM-DD) | | | | — |
| <input type="checkbox"/> Method A | | | | — |
| Ambient temperature [°C] | | | | — |
| Current flow applied [A]..... | | | | — |
| Sample # | VFM | VFMrated | VFM = (N × VFMrated) ± 10 % | Result |
| 1 | | | <input type="checkbox"/> Yes <input type="checkbox"/> No | |
| 4 | | | <input type="checkbox"/> Yes <input type="checkbox"/> No | |
| 5 | | | <input type="checkbox"/> Yes <input type="checkbox"/> No | |
| 7 | | | <input type="checkbox"/> Yes <input type="checkbox"/> No | |
| 9 | | | <input type="checkbox"/> Yes <input type="checkbox"/> No | |
| 14 | | | <input type="checkbox"/> Yes <input type="checkbox"/> No | |
| 15 | | | <input type="checkbox"/> Yes <input type="checkbox"/> No | |

| <input type="checkbox"/> Method B | | | | | | | — |
|-----------------------------------|------------------------------|-----------------------------|------------------------------|-----------------------------|------------------------------|-----------------------------|--------|
| Sample # | IV curve after shading | | | | | | Result |
| | Diode 1 working properly | | Diode 2 working properly | | Diode 3 working properly | | |
| 1 | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | |
| 4 | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | |
| 5 | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | |
| 7 | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | |
| 9 | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | |
| 14 | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | |
| 15 | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | <input type="checkbox"/> Yes | <input type="checkbox"/> No | |
| Supplementary information: | | | | | | | |

| Table 47: MST 33a - Test for general screw connections | | | |
|--|----------------------|-------------|--------|
| Test Date (YYYY-MM-DD) | | | — |
| Sample # | Thread diameter [mm] | Torque [Nm] | Result |
| 1 | | | |
| Supplementary information: | | | |

| Table 48: MST 33b - Test for locking screws | | | |
|---|----------------------|-------------|--------|
| Test Date (YYYY-MM-DD) | | | — |
| Sample # | Thread diameter [mm] | Torque [Nm] | Result |
| 1 | | | |
| Supplementary information: | | | |

| Sample # | 4 | — |
|--|--|--------|
| Table 49: MST 04 - Insulation thickness test | | |
| Test Date (YYYY-MM-DD) | | — |
| Max. System voltage | | — |
| Thickness of insulation acc. datasheet | | — |
| Required thickness of insulation | | — |
| Measurement uncertainty | | — |
| Location | Measured thickness (including uncertainty) | Result |
| | | |
| | | |
| | | |
| Supplementary information: | | |

Attachment 2 – Photo Documentation

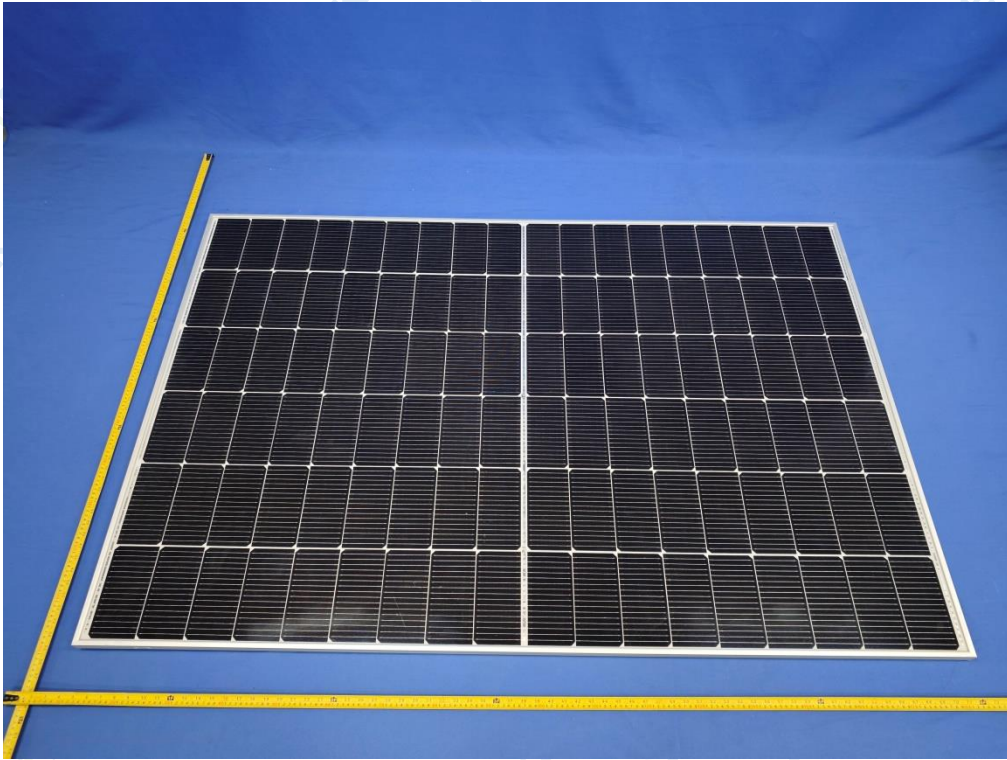


Fig.1



Fig.2



Fig.3

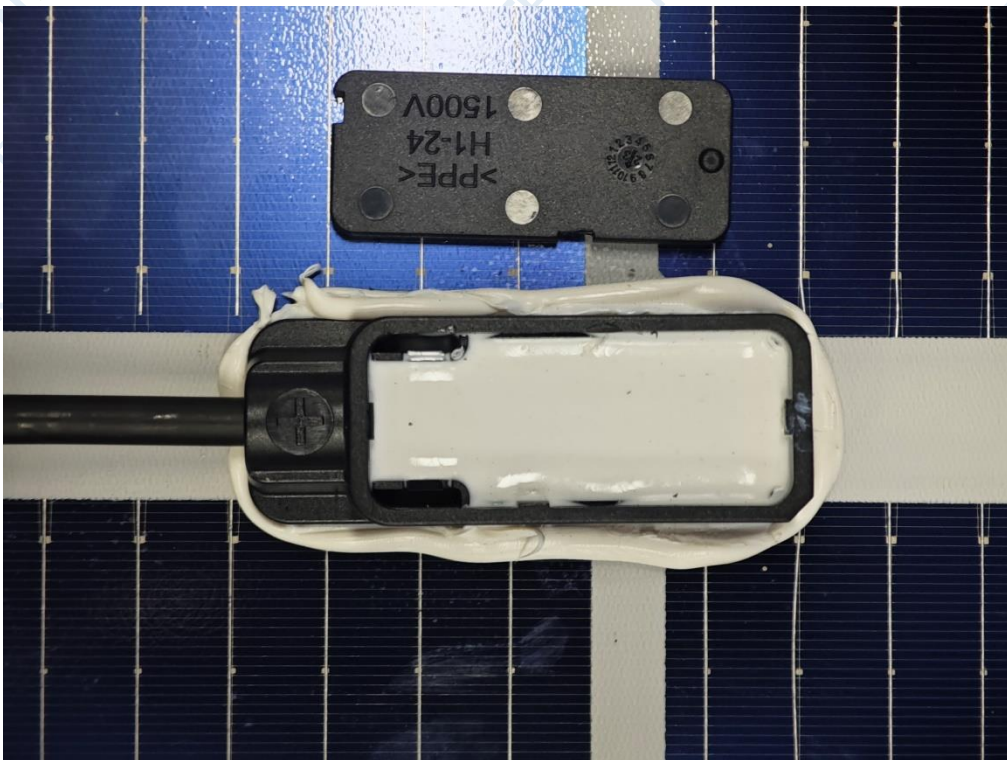


Fig.4

END OF REPORT