

PV module safety qualification
according to
IEC 61730:2004
EN 61730:2007

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Overview

The long term environmental tests of the EN IEC 61215 (resp. EN IEC 61646) do not cover the aspects of electrical safety adequately. Therefore, in the past, the TÜV developed test procedure for the qualification of PV modules as Safety Class II equipment (double or reinforced insulation) has gained world wide reputation.

Most parts of this TÜV-standard, together with some other international requirements, were accepted as the international standard **IEC 61730 “Photovoltaic (PV) module safety qualification”**, which was later issued as the European standard EN 61730 (with minor modifications).

The EN IEC 61730 consists of 2 parts:

- Part 1: Requirements for construction
- Part 2: Requirements for testing

Part 1 of the EN IEC 61730 defines the mandatory design characteristics of the modules (such as minimum distances of conductive parts from the module edges, wall thickness of the junction boxes, etc.) as well as requirements on the materials used in the module (UV-stability, temperature parameters, protection class, etc.).

The qualification work involves checking these requirements on the basis of technical drawings and approvals provided by the manufacturer. Supplementary tests may be performed in the absence of such proof.

Part 2 of the EN IEC 61730 defines three different *Application Classes* for a module design, specifying the type of use, the related qualification tests and the resulting safety class:

| Application Class | System Voltage | | Safety Class |
|------------------------------------|----------------------|-----------------------|--------------|
| | acc. IEC 61730 | acc. EN 61730 | |
| A: General applications | > 50 V _{DC} | > 120 V _{DC} | II |
| B: Restricted access | > 50 V _{DC} | > 50 V _{DC} | 0 |
| C: Low voltage applications | < 50 V _{DC} | < 120 V _{DC} | III |

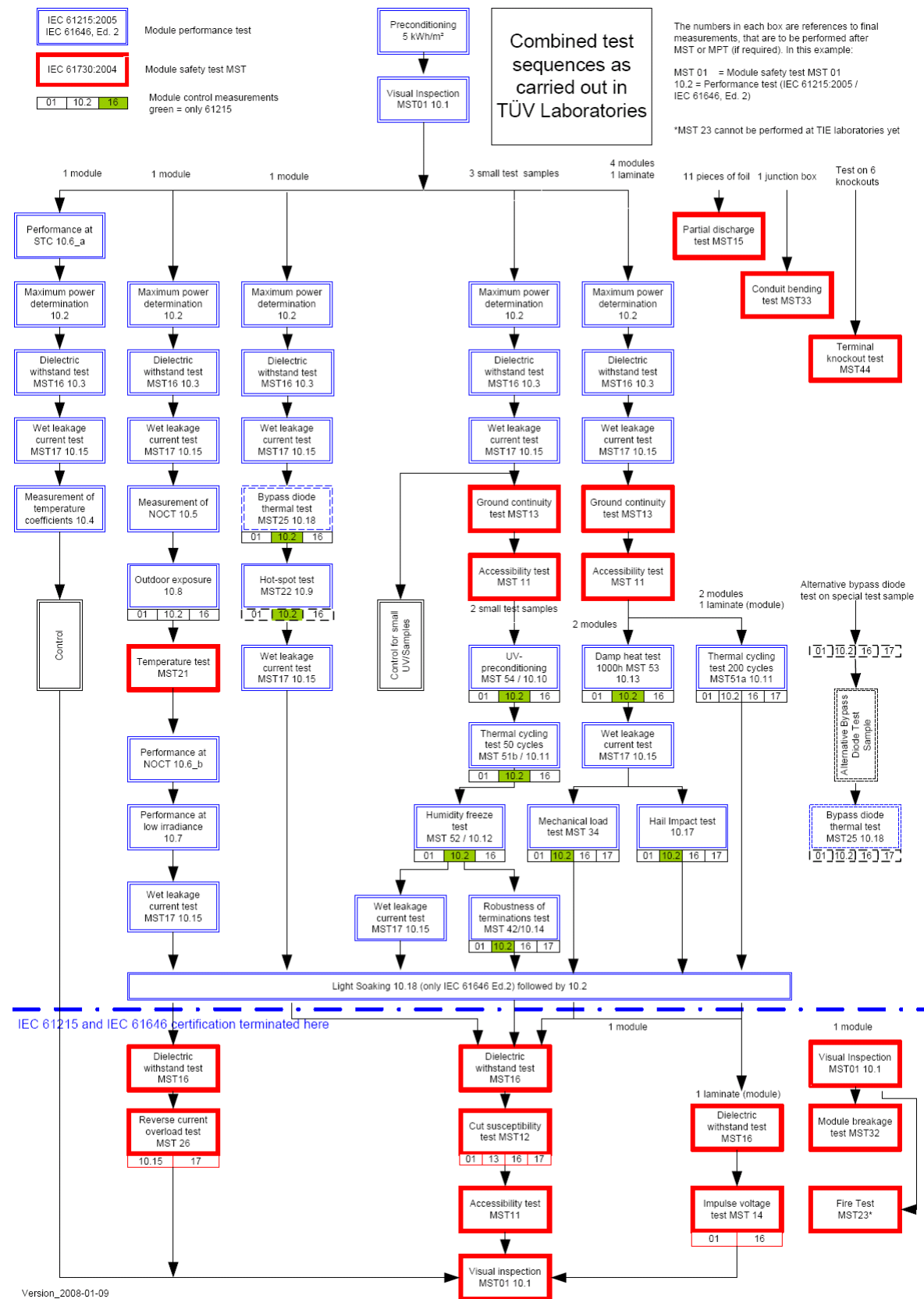
Tests are performed both on complete solar modules (with and without frames) and on individual module components (junction box, backside foil).

A special requirement from EN IEC 61730 is that the test samples have to be preconditioned with environmental tests as described in EN IEC 61215 resp. 61646 (type approval of PV modules) prior to the actual safety tests.

It is therefore recommendable to combine testing acc. EN IEC 61215 resp. EN IEC 61646 with the tests of EN IEC 61730 for the qualification. In this way test samples that have already passed the environmental tests of EN IEC 61215 resp. EN IEC 61646 can be used for the safety tests of the EN IEC 61730.

Such a combination is resulting in a testing tree, which covers both standards in an optimal way:

Combined Test-sequence for EN IEC 61215/61646/IEC 61730



Certification and test mark

To obtain a test certificate all relevant requirements on design and materials in accordance with the specifications of EN IEC 61730 – Part 1 as well as the respective pass criteria of the individual safety tests corresponding to EN IEC 61730 – Part 2 must be fulfilled.

As with the type approval certification according to EN IEC 61215 resp. EN IEC 61646, a test certificate always refers to the type of module on which the tests were performed. This version is supposed to represent the worst case in a PV module type family, generally defined by the following (deviations possible):

- Largest module dimensions
- Maximum output power
- Minimum cell-, string- and edge-distances
- Statically most critical module design and module mounting

An issued certificate may also cover smaller, or less critical, modules of the type family with otherwise identical design (i.e. the same components and materials).

Following certification with a factory inspection, the 'TUVdotCOM' test mark pictured below is issued and provided to the module manufacturer for that manufacturer's own use.

The assigned individual ID number also allows direct product-related access in the global TÜV internet portal (www.tuv.com or www.tuvdotcom.com), where the certified PV module types, the corresponding test documentation and, if desired, also performance features and further product and manufacturer information are available.



[Qualified, EN IEC 61215](#)

[Qualified, EN 61730](#)

[Periodic inspection](#)

Overview of qualification tests according to IEC 61730 – Part 2 (Application class A)

| Code | Test name | Test description / Pass criteria |
|-------------|-------------------------------|---|
| MST 01 | Visual inspection | According detailed inspection list |
| MST 11 | Accessibility test | Resistance always >1 MΩ between test fixture (acc. IEC 61032) and module life parts |
| MST 12 | Cut susceptibility test | Meet insulation requirements after defined cutting on module backside film |
| MST 13 | Ground continuity test | Resistance < 0,1 Ω between marked grounding point and frame points in distance at a current that equals 2,5 times the maximum over-current protection rating of the module (for a minimum of 2 minutes) |
| MST 14 | Impulse voltage test | High voltage impulse depending on selected application class and max. system voltage with a laminate wrapped in copper foil |
| MST 15 | Partial discharge test | Determination of the partial discharge behaviour of the modules backside foil |
| MST 16 | Dielectric withstand test | High voltage test with 2000 V DC + 4 x max. systems voltage at STC for 1 min (Leakage current <50μA), |
| MST 17 | Wet leakage test | Evaluation of insulation of the module under wet conditions; measurement of leakage current at 500 V DC |
| MST 21 | Temperature-test | Compliance of the measured material temperatures with the max. permissible values given in IEC 61730, Table 9 under >700 W/m ² irradiation, wind speed < 1 m/s, environmental temp. 20 – 55 °C |
| MST 22 | Hot-Spot test | 5 hour exposure to > 700 W/m ² irradiance in worst-case hot-spot condition |
| MST 23 | Fire test | Proof according to ANSI/UL790, that the module meet the minimum fire resistance rating of Class C |
| MST 25 | Bypass diode thermal test | Asses adequacy of thermal design of by-pass diodes at a current of 1.25 x I _{sc} running through the diodes at module temperature of 75°C |
| MST 26 | Reverse current overload test | Reverse current through the module equal to 135 % of the module's over-current protection rating for 2 hours |
| MST 32 | Module breakage test | Mechanical impact by a test-bag with a weight of 45,5 kg (ca. 540 J kinetic energy); Requirements for breakage (shards < 6,5 cm ²) |
| MST 33 | Conduit bending test | Test of the ability of a possible conduit fixed to the junction box to withstand a bending force (220 to 49 N, depending on diameter) |
| MST 42 | Robustness of Terminations | As in IEC 60068-2-21 |
| MST 44 | Terminal knockout test | Test of the suitability of terminal knockouts |
| MST 51 a/b | Thermal Cycling | 50 and 200 cycles -40°C to +85°C |
| MST 52 | Humidity Freeze Test | 10 cycles -40°C to +85°C, 85% RH |
| MST 53 | Damp Heat | 1000 h at +85°C, 85% RH |
| MST 54 | UV-exposure test | Min.15 kWh/m ² UV-radiation (280 - 400 nm) with 7.5 kWh/m ² UV-radiation (280 - 320 nm) at 60°C module temperature |