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Ministry of New & Renewable Energy
(Standards & Quality Control Division)

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Revised Guidelines for series approval of SPV Modules for conducting testing in Test Labs for implementation of Solar Photovoltaics Systems, Devices and Component Goods Order 2017.

The guidelines are issued to facilitate labs/manufacturers in formation of series of products for approval of product family including change in design, materials, etc. for performance testing of SPV Modules in test labs for compulsory registration with BIS for implementation of the Solar Photovoltaics Systems, Devices and Component Goods Order 2017. However, in the case of SPV Modules of capacities ranging from 0.2 to 20W used in solar luminaries applications, it has been decided that Modules of capacities up to 5W used for solar lantern applications will be tested as per IS 16476(Part I) and for testing modules in the range 5-20W appropriate standard will be brought out by BIS. This item will be included in the revised Quality Control Order for notification. Till such time SPV Modules of capacities ranging from 0.2 to 20 W used in solar luminaries are excluded in the series guidelines for BIS registration. The following series guidelines will now be followed for conducting tests on SPV Modules (crystalline and thin film, including bifacial type) by test labs.

Definition of Product Family

A product family can be defined by the maximum configuration of components/sub-assemblies plus a description of how the models are constructed from the maximum configuration using these component and sub-assemblies. All models which are included in the family typically have common design, construction, parts or assemblies essential to ensure conformity with applicable requirements.

Out of the entire range of models intended to be covered under registration, the highest rated model shall be tested to cover the entire range of family. The lab will be required to charge the cost of testing only for the highest rated module and test report can be issued to all such sets of lower wattage and higher wattage modules. Product label of each series model shall be placed in the test report. If there is a change in BOM in the family then the retesting guidelines will be followed for submitting samples to test Labs, and for which appropriate testing charges will be made by test lab.

Guidelines for Quantitative Selection of Samples

a. IS 14286: 2010, IS 16077:2013 Design Qualification and type approval of crystalline silicon (including bifacial) and Thin Film terrestrial PV modules

A total eight modules shall be taken at random from a production batch or batches, in accordance with the procedure given in IEC 60410. The modules shall have been manufactured from specified materials and components in accordance with the relevant drawings and process sheets and have been subjected to the manufacturer's normal quality

Contd.2

control and production acceptance procedures. The modules shall be complete in every detail and shall be accompanied by the manufacturer's handling, mounting and connection instructions, including the maximum permissible system voltage. The modules should contain the bypass diode wherever applicable. In case of the modules with sealed junction box the client should provide one extra module having access to the diode for conducting the bypass diode test.

All the modules should contain the following clear and indelible marking laminated inside the glass as per IS/IEC 61730-1, clause 11.

- i. Name, monogram or symbol of manufacturer;
- ii. Model number
- iii. Unique serial number
- iv. Nominal wattage $\pm 2\%$
- v. Year and country of origin
- vi. Brand name if applicable

Other details as per IS/IEC 61730-1 clause 11 should be provided at appropriate place. The actual Power Output P_{max} shall be mentioned on the label pasted on the back side of PV Module. In case of thin film modules information need not be provided laminated inside the glass, however, it should be provided as per IS/IEC 61730-1 clause 11 at an appropriate place with clear and indelible marking

In addition to the above, the following information should also be provided

- Polarity of terminals or leads (colour coding is permissible) on junction Box housing near cable entry or cable and connector.
- The Maximum system voltage for which the module is suitable to be provided on the back sheet of the module.

The Test laboratory should not accept the modules for testing without above detail. However, in case the samples have already been submitted to Test Labs are in the process of submission, the concerned manufacturers will be required to submit an undertaking for compliance of the instructions contained in these guidelines to BIS for granting registration. All other manufacturers who have already got registration from BIS shall include mandatory marking inside the laminate and actual power output on the label on the backside of the SPV panel. The testing sequence and the pass criterion should be strictly followed in accordance with the test standard

b. IS/IEC 61730-2: 2004 PV module safety qualification and; Requirement for testing

A total 7 Nos. of PV modules (6 Nos. normal modules and one laminate) shall be taken for testing. Laminate sample testing as per clause 10.5/MST 14. All these modules should fulfill the requirement as stated above for IS 14286: 2010 Design Qualification and type approval of crystalline silicon terrestrial PV modules and IS 16077:2013 for thin film Solar

Modules. In case the module is sold with frame impulse voltage test to be conducted on the module with frame.

c. IS/IEC 61730-1: 2004 PV module safety qualification and; Requirement for construction

The client should submit all the details of Bill of materials & fabrication etc. in accordance with the standard IS/IEC 61730-1: 2004. The necessary IS/IEC compliance certificates where available and applicable for the pre-certified bill of material should also be submitted to the Laboratory for review. For components, the certification should be as per IS/IEC where available and applicable, and, in case such standards are not available, other IEC harmonized standards shall be acceptable.

d. Retesting guide lines: Product or process modifications requiring limited retesting to maintain the certification

In case of change in cell technology, modification to encapsulation system, modification to substrate, increase in module size, modification to back sheet material, modification to junction box, change in cell interconnect material or technology, change in electrical circuit of an identical package, modification to frame higher or lower power output (by 10%) in the identical package without change in size and cell process & modules without frame the requirement of limited testing for extending the certification to the module family should be followed strictly as per CTL decision sheet DSH0647A:2010 enclosed at Annexure I for design qualification and type approval (IS14286/ IEC61215, IS 16077) and DSH 770: 2010 enclosed at Annexure II for photovoltaic module safety qualifications as per IS/IEC 61730-2 - 1:2004 and IS/IEC 61730-2:2004 guidelines*: While the retest guidelines PDSH 770 : 2010 allows increase in module size by 20% in length and width, there is no limit to decrease in module size.

*In case of the crystalline silicon modules constructed by using the cut cells while maintaining the same number or area of interconnects and equivalent number of solder bonds per unit area for extending the certificate to other models hot spot test, reverse current overload test and bypass diode thermal test should be conducted on the module of the model which contains maximum number of cut cells of smallest area in the family. Further, the model in which the cut cells does not meet the requirement of same number or area of interconnects and equivalent number of solder bonds per unit area shall not be considered under the category of limited testing to maintain the certificate. In case number of cells per by pass diode increase from the base model then only bypass diode test to be conducted.

e. Pass criteria

Pass criteria for module should be as per the clause number 6 of IS 14286 and IS 16077.

f. Fire Test

For conducting fire test, the requirement of number of fire tests samples will depend on the size of the PV panel and fire safety class declared by the manufacturer and for this additional 3 nos. modules are required to be submitted to the test lab.

g. Brands

Different brands are required to be registered separately. However, it is feasible to do so based on a common test report, if the product and the manufacturing location are the same.

All brands with respective model numbers should be listed in the test report. Test samples of all brands are not required to be submitted. However, product labels for respective brands must be placed in the test report. Lab may also include statement about coverage of this brand and respective model numbers to be covered based on the representative model tested and the declaration submitted by the manufacturer about multiple brands and respective model numbers.

Please refer to "Process for Registration" under Registration Scheme available at BIS website www.crsbis.in.

CTL (PROVISIONAL) DECISION SHEET

Standard(s)- (incl. year) IEC 61215:2005 Ed.2 IEC 61646:2008 Ed.2	Sub-clause(s): See individual items	No. PDSH 0647A	Year 2010
Category: PV		Developed by: ETF 9	
Subject: Retest Guidelines for IEC 61215 and IEC 61646	Key words: PV module, modifications, retest guidelines	To Be Approved at the 48TH (2011) CTL Plenary Meeting	
<p>Question:</p> <p>When a PV module design, materials, components or processing has certain modifications, what are the requirements of limited retesting to maintain its original IEC61215 or IEC61646 certification?</p> <p>Decision:</p> <p>This Decision Sheet sets forth a uniform approach to maintain the certification of PV modules that have, or will, undergo modification from the articles originally certified.</p> <p>Changes in material selection, components and manufacturing process can impact electrical performance and reliability of the modified product. The recommended test sequences given below have been selected to identify adverse changes to the modified product.</p> <p>Those products meeting the requirements of the relevant standard after retesting are considered to be compliant and will be issued an amended CB Conformity Assessment Certificate and an Amended Technical Report Form.</p> <p>The number of samples to be included in the retesting program and the pass/fail criteria is to be taken from the standard originally used to certify the product (either IEC 61215 or IEC 61646).</p> <p>The document is organized by major modification headings and specific supporting examples. Following this is the recommended retesting sequence with parenthetical reference to the specific clauses of the relevant IEC standards.</p> <p>For the modifications listed below, the Qualification Approval tests in IEC 61215 and IEC 61646 shall be used as a guideline by the National Certification Body (NCB) and Certification Body Testing Laboratory (CBTL).</p> <p>For the modifications listed below, the Qualification Approval tests in IEC 61215 and IEC 61646 shall be used as a guideline by the assessors.</p>			

Any change in the design, materials, components or processing of the module may require a repetition of some or all of the qualification tests to maintain type approval. Each module delivered for this modification section shall be subjected to preconditioning and then checked against the STC power rating on the label. The following list provides guidance as to which tests should be repeated.

Note 1: Tests 10.1, 10.2, 10.3 and 10.15 shall be performed before and after the specific tests listed below.

Note 2: In case of IEC 61646 approval test:
Specifics for thin film cell changes are under consideration;
Final light soaking (10.19) test is compulsory for all test samples.

a) Change in cell technology

For modifications such as:

- Metallization materials and/or process
- Anti-reflective coating material
- Type of diffusion process
- Semiconductor layer materials
- Order of cell process if the change involves the metallization system
- Change of manufacturing site of the solar cells not under the same QA system,
- Use of cells from a different manufacturer
- Major reduction in cell thickness (greater than 25% for cell thickness > 200 μm and greater than 17.5% for cell thickness \leq 200 μm)

Repeat:

- Thermal cycling, 200 cycles (10.11)
- Damp heat (10.13), may be omitted if outer surface of cell is chemically identical (metallization and AR coating)
- Hot spot endurance (10.9)
- Mechanical Load test (10.16) for reduction of cell thickness only

b) Modification to encapsulation system

For modifications such as:

- Different materials
- Different additives
- Different encapsulation process e.g. curing rate

Repeat:

- UV (10.10) / thermal cycling, 50 cycles (10.11) / humidity freeze sequence (10.12)
- Damp heat (10.13)
- Hail impact (10.17) if not tempered glass
- Hot spot (10.9) if material composition changes

c) Modification to superstrate

For modifications such as:

- Different material
- Different thickness, reduced by more than 10%
- For glass, if there is a reduction in the heat strengthening process (for example, if a change is from tempered glass to heat strengthened or annealed)
- Different surface treatments, adhesives or primers if they are in direct contact with encapsulate material
- If the change is from glass to non-glass or vice-versa, it should be considered a new product altogether

Repeat:

- UV (10.10) / thermal cycling, 50 cycles (10.11) / humidity freeze (10.12) sequence
- Mechanical load test (10.16)
- Hail test (10.17)
- Damp heat (10.13) (if non-glass)
- Hot spot (10.9) for non-glass if material changes or thickness is reduced
- Outdoor exposure (10.8) if change in material

d) Increase in module size

- For increase by more than 20% of length or width

Repeat:

- Thermal cycling, 200 cycles (10.11)
- Mechanical load (10.16)
- Hail impact (10.17) (for size increases of more than 50%)

e) Modification to backsheet/substrate

For modifications such as:

- Different material
- Reduction of thickness of more than 20 %
- Different additives, surface treatments, adhesives and primers

Repeat:

- UV (10.10) / thermal cycling, 50 cycles (10.11) / humidity freeze (10.12) sequence
- Robustness of terminations (10.14)
- Damp heat (10.13) (if non-glass)
- Hail impact (10.17) if rigidity depends on the backsheet
- Mechanical load (10.16) if mounting depends on the backsheet/substrate

If there is a change from superstrate to substrate design or from substrate to superstrate design, the entire qualification test sequence in IEC 61215 shall be conducted.

f) Modification to frame and/or mounting structure

For modifications such as:

- Cross section of frame
- Different framing material
- Different mounting technique

Repeat:

- Mechanical load test (10.16)
- Outdoor exposure (10.18) if plastic material is used
- UV (10.10) / thermal cycling (10.11), 50 cycles / humidity freeze (10.12) sequence, if plastic material is used
- Damp heat (10.13) if an adhesive system is used to mount the module
- Thermal cycling (10.11), 200 cycles, if an adhesive system is used to mount the module

g) Modification to junction box/electrical termination

For modifications such as:

- Different material
- Different design
- Different potting material
- Different method of attachment

Repeat:

TC 50 (10.11), 10 HF (10.12)

- Robustness of terminations (10.14)
- Damp heat (10.13)
- By-pass diode thermal test (10.18) (if bypass diode is in the box)

h) Change in cell interconnect materials or technique

For modifications such as:

- Different interconnect material,
- Increased thickness of interconnect material (for thickness increases greater than 40µm. If the new ribbon thickness is below 100µm thickness no retest is required.)
- Different bonding technique
- Different number of interconnects
- Different number of solder bonds per cell
- Different solder material or flux

Repeat:

- Temperature cycling, 200 cycles (10.11)
- Damp heat (10.13) for changes in materials
- Hot spot for changes in bonding technique or solder material (10.9)

i) Change in electrical circuit of an identical package

For modifications such as:

- Modifications to the interconnection circuitry (for example more cells per bypass diode or re-routing of output leads)
- Reconfiguration of voltage (i.e. 12V to 24V)

Repeat:

- Hot spot (10.9), only if more cells per by-pass diode
- By-pass diode thermal test if the current in each diode increases (10.18)
- Temperature cycling, 200 cycles (10.11) if there are internal conductors behind the cells

j) Higher or lower power output (by 10%) in the identical package including size and using the identical cell process

Repeat:

- Hot spot (10.9)
- Bypass diode thermal test (10.18) if greater than 10% higher

k) Qualification of a frameless module after the design has received certification as a framed module

Repeat the following tests with the laminate mounted using the manufacturers mounting instructions:

- Damp heat (10.13) (If frame is part of the package seal)
- Mechanical load (10.16)
- Hail impact (unless superstrate is tempered glass) (10.17)

l) Change in By-pass diode

- Lower current rating or lower temperature rating
- Different number of by-pass diodes per module
- Different type or manufacturer

Repeat:

- Bypass diode thermal test (10.18)

Modifications that do not require re-testing

Provided that all structural components, materials used and processes (including cell process) remain the same, the following modifications shall not require re- testing:

- Fewer cells in module
- Smaller cells in module, as long as each cell has the same number or area of interconnects and equivalent numbers of solder bonds per unit area

Explanatory Notes:

Based on a decision made on 47th IECEE CTL plenary meeting in Marburg, Germany, the PV Retest Guidelines will be treated as a normal Decision Sheet, and all previously published Guidelines will be moved to DSH.

With the publication of this DSH 0647A, following two documents will be withdrawn:

- 1.DSH 647
- 2.etestGuideline_IEC61215_61646def.pdf.pdf

CTL DECISION SHEET

Standard(s)- (incl. year) IEC61730-1:2004 Ed. 1 IEC61730-2:2004 Ed. 1	Sub-clause(s): See individual items	No. DSH 770	Year 2010
Category: PV		Developed by: ETF 9	
Subject: Retest Guidelines for IEC 61730-1/2	Key words: PV module, modifications, retest guidelines	Approved at: 48th CTL Plenary Meeting, 2011 Geneva	
<p>Question:</p> <p>When a PV module design, materials, components or processing has certain modifications, what are the requirements of limited retesting to maintain its original IEC61730-1/-2 certification?</p> <p>Decision:</p> <p>This Decision Sheet sets forth a uniform approach to maintain the safety certification of products that have, or will, undergo modification from the articles originally certified. It should not be used as a guideline to certify new product submittals.</p> <p>Changes in material selection, components and manufacturing process can impact the safety of the modified product. The recommended test sequences given below have been selected to identify adverse changes to the modified product.</p> <p>Those products meeting the requirements of the relevant standard after retesting are considered to be compliant and will be issued an amended CB Conformity Assessment Certificate and an Amended Technical Report Form.</p> <p>The number of samples to be included in the retesting program and the pass/fail criteria is to be taken from the standard originally used to certify the product (IEC 61730-1/-2).</p> <p>The document is organized by major modification headings and specific supporting examples. Following this is the recommended retesting sequence with parenthetical reference to the specific clauses of the relevant IEC standard.</p> <p>For the modifications listed below, the Module Design Requirements and the Module Safety Tests in IEC 61730-1/-2, shall be used as a guideline by the National Certification Body (NCB) and Certification Body Testing Laboratory(CBTL). For the modifications listed below, the Module Design Requirements and the Module Safety Tests in IEC 61730-1/-2, shall be used as a guideline by the assessor.</p>			

a) Change in cell technology

For modifications such as:

- Metallization materials and/or process
- Anti-reflective coating material
- Type of diffusion process
- Semiconductor layer materials
- Order of cell process if the change involves the metallization system
- Change of manufacturing site of the solar cells not under the same QA system
- Use of cells from a different manufacturer
- Major reduction in cell thickness (greater than 25%)

Repeat:

- Hot spot test (MST 22)
- Reverse current overload (MST 26)
- Temperature test (MST 21)

b) Modification to encapsulationsystem

For modifications such as:

- Different materials
- Different additives
- Different encapsulation process (e.g. curing rate)

Repeat:

- Damp heat (MST 53)
- Wet leakage current (MST 17)
- Dielectric Withstand (MST16)
- Hot spot (MST 22) if material composition changes
- Cut Susceptibility (MST 12), Impulse Voltage (MST 14) if material composition changes
- Fire test (MST 23) if material composition changes, and Module Breakage test (MST 32) if material composition changes
- Thermal cycling (MST 51, T50) and Humidity freeze (MST 52, 10HF)

b) Modification tosuperstrate

For modification such as:

- Different material
- Different thickness, reduced by more than10%

For glass, if there is a reduction in the heat strengthening process (for example, if a change is from tempered glass to heat strengthened or annealed)

Different surface treatments, adhesives or primers if they are in direct contact with encapsulate material

If the change is from glass to non-glass or vice-versa, it should be considered a new product altogether

Repeat:

- Damp heat (MST 53) (if non-glass)
- Wet leakage current test (MST 17) (if non-glass)
- Hot spot (MST 22) if material changes or thickness reductions
- Dielectric withstand test (MST 16) (if non-glass), Cut susceptibility test (MST 12) (if non-glass)
- Impulse voltage test (MST 14) (if non-glass or if glass thickness is reduced)
- Fire test (MST 23) if change in material
- Module breakage test (MST 32) if material or thickness changes
- Mechanical load test (MST 34) (for glass thickness reduction or material changes)

d) Increase in module size

For increase by more than 20% of length or width:

- Module breakage test (MST 32)
- Mechanical load test (MST 34)

e) Modification to backsheet/substrate

For modifications such as:

- Different material
- Different thickness
- Different additives, surface treatments, adhesives and primers

Repeat:

- Damp heat (MST 53) (if non-glass)
- Wet leakage current test (MST 17)
- Dielectric withstand test (MST 16) (if non-glass), Cut susceptibility test (MST 12) (if non-glass)
- Impulse voltage test (MST 14) (if non-glass) Fire test (MST 23) if change in material

Temperature test if change in material (MST 21)

Partial discharge test (MST 15) if non-glass and a change in material or thickness

If there is a change from superstrate to substrate design or from substrate to superstrate design, the entire safety test sequence in IEC 6730 shall be conducted.

f) Modification to frame and/or mounting structure

For modifications such as:

- Cross section of frame
- Different framing material
- Different mounting technique

Repeat:

- Damp heat (MST 53) if an adhesive system is used to mount the module and there is a surface contact reduction between laminate and frame
- Dielectric withstand (MST16) if the area or location of contact to the laminate changes
- Wet leakage current (MST 17) if the area or location of contact to the laminate changes
- Ground continuity test (MST 13) (if change in method of assembly)
- Fire test (MST 23) if the new frame material is flammable

g) Modification to junction box/electrical termination

For modifications such as:

- Different material
- Different design
- Different potting material
- Different method of attachment

Repeat:

- Damp heat (MST 53)
- Wet leakage current test (MST 17)
- Dielectric withstand test (MST 16)
- Accessibility test (MST 11)
- Conduit bending test (MST 33) if thickness reduction or polymer material changes
- Terminal box knockout test (MST 44) if thickness reduction or polymer material changes

h) Change in cell interconnect materials or technique

For modifications such as:

- Different interconnect material
- Different thickness of interconnect material
- Different bonding technique
- Different number of interconnects
- Different number of solder bonds
- Different solder material or flux
- Different solder material or flux

Repeat:

- Hot spot for changes in bonding technique or solder material (MST22)
- Reverse current test (MST26)

i) Change in electrical circuit of an identical package

For modifications such as:

- Modifications to the interconnection circuitry (for example more cells per bypass diode or re-routing of output leads)
- Reconfiguration of voltage (i.e. 12V to 24V)

Repeat:

- Hot spot (MST 22)
- Temperature Test (MST 21)
- Reverse current overload test (MST 26)

j) Higher power output (by 10% or more) in the identical package including size and using the identical cell process

Repeat:

- Hot spot (MST 22)
- Reverse current overload test (MST 26)

k) Qualification of a frameless module after the design has received certification as a framed module

Repeat the following tests with the laminate mounted using the manufacturers mounting instructions:

- Damp heat (MST 53) (If frame is part of the package seal)
- Wet leakage current (MST 17)
- Dielectric withstand test (MST 16)
- Mechanical load test (MST 34)
- Module breakage test (MST 32)

Modifications that do not require re-testing

Provided that all structural components, materials used and processes (including cell process) remain the same, the following modifications shall not require re- testing:

fewer cells in module

Smaller cells in module, as long as each cell has the same number of interconnects and equivalent numbers of solder bonds per unit area

- Up to 20% larger module area with the same number of cells

Explanatory Notes:

Based on a decision made on 47th IECEE CTL plenary meeting in Marburg, Germany, the PV Retest Guidelines will be treated as a normal Decision Sheet, and all previously published Guidelines will be moved to DSH.

With the publication of this DSH 0769, following document will be withdrawn:
Retest_Guideline_IEC61730def.pdf