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Junction boxes for photovoltaic modules – Safety requirements and tests

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**JUNCTION BOXES FOR PHOTOVOLTAIC MODULES –
SAFETY REQUIREMENTS AND TESTS**

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International Standard IEC 62790 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) Modifications in normative references and terms and definitions;
- b) Improvement of declaration of categories for junction boxes in 4.1;
- c) Clarification for ambient temperature in 4.1;
- d) Addition of requirement to provide information concerning RTE/RTI or TI in 4.2;
- e) Reference to IEC 62930 instead of EN 50618 in 4.6;
- f) Addition of "Functional insulation" in Table 1;
- g) Addition of "Distance through cemented joints" in Table 3;
- h) Correction of procedure of process to categorize material groups (deletion of PTI) in 4.15.2.3;
- i) Requirement for approval of RTE/RTI or TI for insulation parts in 4.16.1 and 4.16.2;
- j) Change of requirements concerning electrochemical potential in 4.17.2;
- k) Clarification for IP-test in 5.3.4.2;
- l) Addition of test voltage for cemented joints in 5.3.6 and 5.3.16;
- m) Addition of detailed description on how to prepare the test sample for the thermal cycle test in 5.3.9.1;
- n) New test procedure for bypass diode thermal test (5.3.18) in accordance with MQT 18.1 of IEC 61215-2:2016;
- o) New test procedure for reverse overload current test in 5.3.23;
- p) New Figure 1 for thermal cycle test.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
82/1719/FDIS	82/1738/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

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JUNCTION BOXES FOR PHOTOVOLTAIC MODULES – SAFETY REQUIREMENTS AND TESTS

1 Scope

This document describes safety requirements, constructional requirements and tests for junction boxes up to 1 500 V DC for use on photovoltaic modules in accordance with class II of IEC 61140:2004/2016.

This document applies also to enclosures mounted on PV-modules containing electronic circuits for converting, controlling, monitoring or similar operations. Additional requirements concerning the relevant operations are applied under consideration of the environmental conditions of the PV-modules. This document does not apply to the electronic circuits of these devices, for which other IEC standards apply.

NOTE For junction boxes in accordance with classes 0 and III of IEC 61140:2004/2016, in photovoltaic-systems, this document can be used as a guideline.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-70, *Environmental testing – Part 2-70: Tests – Test Xb: Abrasion of markings and letterings caused by rubbing of fingers and hands*

IEC 60068-2-75, *Environmental testing – Part 2-75: Tests – Test Eh: Hammer tests*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

~~IEC 60228, *Conductors of insulated cables*~~

IEC 60216-1, *Electrical insulating materials – Thermal endurance properties – Part 1: Ageing procedures and evaluation of test results*

IEC 60216-5, *Electrical insulating materials – Thermal endurance properties – Part 5: Determination of relative thermal endurance index (RTE) of an insulating material*

IEC 60352-2, *Solderless connections – Part 2: Crimped connections – General requirements, test methods and practical guidance*

~~IEC 60512-12-1, *Connectors for electronic equipment – Tests and measurements – Part 12-1: Soldering tests – Test 12a: Solderability, wetting, solder bath method*~~

~~IEC 60512-12-2, Connectors for electronic equipment – Tests and measurements – Part 12-2: Soldering tests – Test 12b: Solderability, wetting, soldering iron method~~

IEC 60352-3, Solderless connections – Part 3: Solderless accessible insulation displacement connections – General requirements, test methods and practical guidance

IEC 60352-4, Solderless connections – Part 4: Solderless non-accessible insulation displacement connections – General requirements, test methods and practical guidance

IEC 60352-5, Solderless connections – Part 5: Press-in connections – General requirements, test methods and practical guidance

IEC 60352-6, Solderless connections – Part 6: Insulation piercing connections – General requirements, test methods and practical guidance

IEC 60352-7, Solderless connections – Part 7: Spring clamp connections – General requirements, test methods and practical guidance

IEC 60529, Degrees of protection provided by enclosures (IP Code)

IEC 60664-1:2007, Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests

~~IEC/TR 60664-2-1, Insulation coordination for equipment within low-voltage systems – Part 2-1: Application guide – Explanation of the application of the IEC 60664 series, dimensioning examples and dielectric testing~~

~~IEC 60664-3, Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution~~

IEC 60695-2-11, Fire hazard testing – Part 2-11: Glowing/hot-wire based test methods – Glow-wire flammability test method for end-products (GWEPT)

IEC 60695-10-2, Fire hazard testing – Part 10-2: Abnormal heat – Ball pressure test method

IEC 60695-11-10, Fire hazard testing – Part 11-10: Test flames – 50 W horizontal and vertical flame test methods

IEC 60695-11-20:1999, Fire hazard testing – Part 11-20: Test flames – 500 W flame test method

~~IEC/TR 60943, Guidance concerning the permissible temperature rise for parts of electrical equipment, in particular for terminals~~

IEC 60947-7-1, Low-voltage switchgear and controlgear – Part 7-1: Ancillary equipment – Terminal blocks for copper conductors

~~IEC 60998-2-1, Connecting devices for low-voltage circuits for household and similar purposes – Part 2-1: Particular requirements for connecting devices as separate entities with screw-type clamping units~~

~~IEC 60998-2-2, Connecting devices for low-voltage circuits for household and similar purposes – Part 2-2: Particular requirements for connecting devices as separate entities with screwless-type clamping units~~

IEC 60998-2-3, *Connecting devices for low-voltage circuits for household and similar purposes – Part 2-3: Particular requirements for connecting devices as separate entities with insulation-piercing clamping units*

IEC 60999-1:~~2000~~1999, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 1: General requirements and particular requirements for clamping units for conductors from 0,2 mm² up to 35 mm² (included)*

IEC 60999-2, *Connecting devices – Electrical copper conductors – Safety requirements for screw-type and screwless-type clamping units – Part 2: Particular requirements for clamping units for conductors above 35 mm² up to 300 mm² (included)*

IEC 61032, *Protection of persons and equipment by enclosures – Probes for verification*

IEC 61140:~~2001~~2016, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61191-1, *Printed board assemblies – Part 1: Generic specification – Requirements for soldered electrical and electronic assemblies using surface mount and related assembly technologies*

IEC 61210, *Connecting-devices – Flat, quick-connect terminations for electrical copper conductors – Safety requirements*

IEC 61215-1:2016, *Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1: Test requirements*

IEC 61215-2:2016, *Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 2: Test procedures*

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

~~IEC 61730-2:2004, Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing~~

IEC 62852, *Connectors for DC-application in photovoltaic systems – Safety requirements and tests*

IEC 62930, *Electric cables for photovoltaic systems with a voltage rating of 1,5 kV DC*

ISO 868:2003, *Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 4892-2:~~2013~~, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

ISO 4892-3:~~2006~~, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*

~~EN 50618, Electric cables for photovoltaic systems~~

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC TS 61836 as well as the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

3.1

module junction box

combination of parts, such as boxes, covers, cover-plates, lids, box extensions, accessories, etc., providing after assembly and installation at the photovoltaic-module in normal use, an appropriate protection against external influences, and a defined protection against contact with enclosed live parts from any accessible direction

3.1.1

junction box for re-opening

junction box that can be opened at any time

Note 1 to entry: It may contain rewirable and non-rewirable connections.

3.1.1.1

junction box for factory wiring

junction box which is attached and connected to the PV module under controlled conditions, usually at the manufacturer's location

3.1.1.2

junction box for field wiring

junction box containing wiring connections that are intended to be made in the field

3.1.2

junction box, not intended to be re-opened

junction box that cannot be opened after mounting in the end application

~~Note 1 to entry: It may contain rewirable and non-rewirable connections.~~

3.2

cable gland

device permitting the introduction of one or more electric cables into the junction box so as to maintain the relevant type of protection

[SOURCE: IEC 60050-426:2008, 426-04-18, modified – "and/or fibre optics" has been deleted and "an electrical apparatus" has been replaced by "the junction box".]

3.3

sealing

method for providing the ability of a component to resist the ingress of contaminants

[SOURCE: IEC 60050-581:2008, 581-23-16]

3.4

spout hub

~~open entry of a box permitting the insertion and containment of a conduit~~

3.4**cable anchorage**

ability to limit the displacement of a fitted flexible cable against pull and push forces and torques

3.5**connector for photovoltaic-systems****PV-connector**

component suitable for use in PV systems that terminates conductors for the purpose of providing connection to and disconnection from a suitable mating component

3.6**intended use**

use of a junction box in accordance with the information for use provided by the manufacturer

[SOURCE: IEC 60050-903:2013, 903-01-13, modified – "product, process or service" has been replaced by "junction box" and "supplier" has been replaced by "manufacturer".]

3.7~~**terminal**~~**clamping unit**

part(s) of the terminal necessary for the mechanical clamping and the electrical connection of the conductor(s), including the parts that are necessary to ensure the correct contact pressure

3.8**clearance**

shortest distance in air between two conductive parts

[SOURCE: IEC 60050-426:2008, 426-04-12, modified – The note was deleted.]

3.9**creepage distance**

shortest distance along the surface of the insulating material between two conductive parts

[SOURCE: IEC 60050-151:2001, 151-15-50, modified – "a solid insulating material" has been replaced by "the insulating material".]

3.10**overvoltage category**

numeral defining a transient overvoltage condition

[SOURCE: IEC 60050-581:2008, 581-21-02]

3.11**pollution**

any addition of foreign matter, solid, liquid, or gaseous that can result in a reduction of electric strength or surface resistivity of the insulation

[SOURCE: IEC 60050-442:1998, 442-01-28, modified – Definition revised and note deleted.]

3.12**pollution degree**

numeral characterising the expected pollution of the micro-environment

[SOURCE: IEC 60050-581:2008, 581-21-07]