IEC 62790

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Junction boxes for photovoltaic modules – Safety requirements and tests

Boîtes de jonction pour modules photovoltaïques – Exigences de sécurité et essais

IEC 62790:2020-07(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

JUNCTION BOXES FOR PHOTOVOLTAIC MODULES – SAFETY REQUIREMENTS AND TESTS

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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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 61140:2016.

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 61140:2016, 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 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 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 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, *Fire hazard testing – Part 11-20: Test flames – 500 W flame test method*

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

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 60999-1:1999, *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 mm^2 up to 35 mm^2 (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 mm^2 up to 300 mm^2 (included)*

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

IEC 61140:2016, *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 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, *Plastics – Methods of exposure to laboratory light sources – Part 2: Xenon-arc lamps*

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

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

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
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
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]

3.13
rated voltage
value of voltage assigned by the manufacturer to the junction box and to which operation and performance characteristics are referred

Note 1 to entry: Rated voltage is equivalent to the rated system voltage according to IEC 61730-1.

[SOURCE: IEC 60664-1:2007, 3.9, modified – "a component, device or equipment" has been replaced by "the junction box" and the note has been replaced by Note 1 to entry.]

3.14
rated insulation voltage
RMS withstand voltage value assigned by the manufacturer to the junction box, characterising the specified (long term) withstand capability of its insulation

Note 1 to entry: The rated insulation voltage is not necessarily equal to the rated voltage, which is primarily related to functional performance.

[SOURCE: IEC 60664-1:2007, 3.9.1, modified – "equipment or to a part of it" has been replaced by "junction box".]

3.15
rated impulse voltage
impulse withstand voltage value assigned by the manufacturer to the junction box, characterising the specified withstand capability of its insulation against transient overvoltages

[SOURCE: IEC 60664-1:2007, 3.9.2, modified – "equipment or to a part of it" has been replaced by "junction box".]

3.16
impulse withstand voltage
highest peak value of impulse voltage of specified form and polarity that does not cause breakdown of the insulation under specified conditions

Note 1 to entry: The impulse withstand voltage is equal to or higher than the rated impulse voltage.

[SOURCE: IEC 60664-1:2007, 3.8.1, modified – "prescribed" replaced with "specifed" and Note 1 to entry has been added.]

3.17
RMS withstand voltage
power-frequency withstand voltage
highest RMS value of a voltage that does not cause breakdown of insulation under specified conditions

[SOURCE: IEC 60664-1:2007, 3.8.2]

3.18
current

3.18.1
rated current
current value assigned by the manufacturer, which the junction box can carry continuously (without interruption) and simultaneously through all its contacts and bypass-diodes, if applicable, wired with the largest specified conductor, at the maximum ambient temperature, without the upper limiting temperature being exceeded

3.18.2
reverse current
I_{REV}
current value assigned by the manufacturer, which the junction box can carry at the maximum ambient temperature, without causing a hazardous situation

Note 1 to entry: The reverse current is comparable with the reverse test current of the photovoltaic module (see IEC 61730-2).

3.19
functional insulation
insulation between conductive parts that is necessary only for the proper functioning of the equipment

[SOURCE: IEC 60664-1:2007, 3.17.1]

3.20
basic insulation
insulation applied to live parts to provide basic protection against electric shock

Note 1 to entry: This concept does not apply to insulation used exclusively for functional purposes.

[SOURCE: IEC 61140:2016, 3.10.1, modified – "insulation of hazardous-live-parts which provides" has been replaced by "insulation applied to live parts to provide" and "against electric shock" has been added.]

3.21
supplementary insulation
independent insulation applied in addition to basic insulation, in order to provide protection against electric shock in the event of a failure of basic insulation

[SOURCE: IEC 60664-1:2007, 3.17.3, modified – "for fault protection" has been replaced by "in order to provide protection against electric shock in the event of a failure of basic insulation".]

3.22
double insulation
insulation comprising both basic insulation and supplementary insulation

[SOURCE: IEC 60664-1:2007, 3.17.4]

3.23
reinforced insulation
single insulation system applied to live parts, which provides a degree of protection against electric shock equivalent to double insulation

Note 1 to entry: Reinforced insulation may comprise several layers which cannot be tested singly as basic insulation or supplementary insulation.

[SOURCE: IEC 60664-1:2007, 3.17.5, modified – "insulation of hazardous-live-parts" has been replaced by "single insulation system applied to live parts".]

3.24
working voltage
highest RMS value of the DC voltage across any particular insulation which can occur inside the junction box when it operates at rated voltage

[SOURCE: IEC 60664-1:2007, 3.5, modified – "a.c. or" has been removed and “when the equipment is supplied at rated voltage" has been replaced by "inside the junction box when it operates at rated voltage".]

3.25
comparitive tracking index
CTI
numerical value of the maximum voltage in volts which a material can withstand without tracking and without a persistent flame occurring under specified test conditions

[SOURCE: IEC 60050-212:2010, 212-11-59]

3.26
accessible part
part which can be touched by means of standard test finger

[SOURCE: IEC 60050-442:1998, 442-01-15]

3.27
photovoltaic cable
electrical cable (cabling) specifically designed for the purpose of carrying electric current from photovoltaic devices and enduring the environmental conditions commonly encountered in photovoltaic arrays

[SOURCE: IEC TS 61836:2016, 3.2.21, modified – Deletion of the notes to entry.]

3.28
maximum ambient temperature
maximum temperature of the ambient assigned by the manufacturer, in which the junction box is able to operate without the limiting temperatures of the materials (TI, RTE/RTI) being exceeded

4 Constructional requirements and performance

4.1 General

Junction boxes in accordance with this document can be categorized as

– junction boxes, for re-opening;
– junction boxes, not intended to be re-opened.

Junction boxes for re-opening can be distinguished as