



IEC 62790

Edition 2.0 2020-07
REDLINE VERSION

INTERNATIONAL STANDARD



Junction boxes for photovoltaic modules – Safety requirements and tests

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 27.160

ISBN 978-2-8322-8680-7

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD	5
1 Scope	8
2 Normative references	8
3 Terms and definitions	11
4 Constructional requirements and performance	15
4.1 General	15
4.2 Marking and identification	16
4.2.1 Identification	16
4.2.2 Marking	16
4.2.3 Technical documentation	16
4.3 Protection against electric shock	17
4.4 Terminations, connecting devices and connection methods	17
4.5 Connectors	18
4.6 Cables	18
4.7 Resistance to ageing	18
4.8 General design	18
4.9 Degree of protection (IP)	19
4.10 Dielectric strength	19
4.11 Range of ambient temperature	19
4.12 Cable anchorage	19
4.13 Mechanical strength	19
4.14 Insulation	20
4.14.1 Type of insulation	20
4.14.2 Basic insulation	20
4.14.3 Supplementary insulation	20
4.14.4 Double insulation	20
4.14.5 Reinforced insulation	20
4.15 Clearances and creepage distances	20
4.15.1 Clearances	20
4.15.2 Creepage distances	21
4.16 Insulation parts	23
4.16.1 Outer accessible parts	23
4.16.2 Inner parts keeping active parts in position	23
4.17 Current carrying parts and resistance against corrosion	24
4.18 Sealing	24
4.19 Bypass-diode	24
4.20 Knock-out inlets (outlets) intended to be removed by mechanical impact	24
5 Tests	24
5.1 General	24
5.2 Preparation of specimens	26
5.3 Performance of tests	27
5.3.1 General	27
5.3.2 Durability of marking	27
5.3.3 Fixing of lid on rewirable junction box	27
5.3.4 Protection against electric shock	28
5.3.5 Measurement of clearances and creepage distances	28

5.3.6	Dielectric strength.....	28
5.3.7	Resistance to corrosion	28
5.3.8	Mechanical strength at lower temperatures.....	29
5.3.9	Thermal cycle test (IEC 60068-2-14:2009, Test Nb).....	29
5.3.10	Damp heat test	30
5.3.11	Weather resistance test	30
5.3.12	Flammability class	30
5.3.13	Ball pressure test.....	31
5.3.14	Glow wire test.....	31
5.3.15	Resistance against ageing.....	31
5.3.16	Wet leakage current test.....	31
5.3.17	Humidity freeze test.....	32
5.3.18	Bypass diode thermal test.....	33
5.3.19	Test of terminations and connection methods	34
5.3.20	Knock-out inlets (outlets) intended to be removed by mechanical impact	34
5.3.21	Test of cord anchorage	35
5.3.22	Retention on the mounting surface	37
5.3.23	Reverse current test at junction box.....	37
5.4	Test schedule	38
Annex A (informative)	Symbol "Do not disconnect under load"	50
Annex B (normative)	Qualification of conformal coatings for protection against pollution.....	51
B.1	General.....	51
B.2	Technical properties	51
B.3	Qualification of coatings.....	51
Annex C (normative)	Measurement of clearances and creepage distances	54
Bibliography		58
Figure 1 – Thermal cycling test – Temperature and applied current profile		45
Figure 2 – Humidity-freeze cycle.....		45
Figure 3 – Typical arrangement for the cable anchorage pull test.....		46
Figure 4 – Typical arrangement for torsion test		46
Figure 5 – Typical arrangement for flammability test in accordance with 5.3.12.2.....		47
Figure 6 – Measurement of voltage drop		47
Figure 7 – Bypass diode thermal test		48
Figure 8 – Proper attachment of 5 N weight to junction box.....		49
Figure A.1 – Symbol "DO NOT DISCONNECT UNDER LOAD".....		50
Figure A.2 – Symbol "DO NOT DISCONNECT UNDER LOAD" (IEC 60417-6070:2011-06)....		50
Figure C.1 – Examples of methods of measuring clearances and creepage distances.....		57
Table 1 – Required type of insulation		20
Table 2 – Rated impulse voltages and minimum clearances.....		21
Table 3 – Creepage distances for basic insulation		22
Table 4 – Number of specimens.....		25
Table 5 – Values of torque for screw-type clamping units.....		26
Table 6 – Pull forces for cord anchorage.....		36

Table 7 – Values for torsion test	36
Table 8 – Marking, information, documentation, test group A	38
Table 9 – Material test, test group B (single tests)	39
Table 10 – Constructional requirements, test group C (single tests)	40
Table 11 – Mechanical tests, test group D (single tests)	40
Table 12 – Test sequence I, test group E (tests to be performed consecutively in this order).....	41
Table 13 – Test sequence II, test group F (tests to be performed consecutively in this order).....	42
Table 14 – Test sequence III, test group G (tests to be performed consecutively in this order).....	43
Table 15 – Test sequence IV, test group H (tests to be performed consecutively in this order).....	44
Table 16 – Reverse current test, test group I	44
Table 17 – Test sequence V, test group J (tests to be performed consecutively in this order).....	44
Table B.1 – Test parameters, test conditions and test procedures.....	52
Table B.2 – Test sequence and conformity check (tests to be performed consecutively in this order)	53
Table C.1 – Dimensions of X	54

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 61140:20042016.

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 61140:20042016, 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~~

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Junction boxes for photovoltaic modules – Safety requirements and tests

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

CONTENTS

FOREWORD	5
1 Scope	7
2 Normative references	7
3 Terms and definitions	9
4 Constructional requirements and performance	13
4.1 General	13
4.2 Marking and identification	14
4.2.1 Identification	14
4.2.2 Marking	14
4.2.3 Technical documentation	15
4.3 Protection against electric shock	15
4.4 Terminations, connecting devices and connection methods	15
4.5 Connectors	16
4.6 Cables	16
4.7 Resistance to ageing	16
4.8 General design	16
4.9 Degree of protection (IP)	17
4.10 Dielectric strength	17
4.11 Range of ambient temperature	17
4.12 Cable anchorage	17
4.13 Mechanical strength	17
4.14 Insulation	18
4.14.1 Type of insulation	18
4.14.2 Basic insulation	18
4.14.3 Supplementary insulation	18
4.14.4 Double insulation	18
4.14.5 Reinforced insulation	18
4.15 Clearances and creepage distances	19
4.15.1 Clearances	19
4.15.2 Creepage distances	19
4.16 Insulation parts	21
4.16.1 Outer accessible parts	21
4.16.2 Inner parts keeping active parts in position	21
4.17 Current carrying parts and resistance against corrosion	21
4.18 Sealing	22
4.19 Bypass-diode	22
4.20 Knock-out inlets (outlets) intended to be removed by mechanical impact	22
5 Tests	22
5.1 General	22
5.2 Preparation of specimens	23
5.3 Performance of tests	25
5.3.1 General	25
5.3.2 Durability of marking	25
5.3.3 Fixing of lid on rewirable junction box	25
5.3.4 Protection against electric shock	25
5.3.5 Measurement of clearances and creepage distances	26

5.3.6	Dielectric strength.....	26
5.3.7	Resistance to corrosion	26
5.3.8	Mechanical strength at lower temperatures.....	26
5.3.9	Thermal cycle test (IEC 60068-2-14:2009, Test Nb).....	27
5.3.10	Damp heat test	28
5.3.11	Weather resistance test	28
5.3.12	Flammability class	28
5.3.13	Ball pressure test.....	29
5.3.14	Glow wire test.....	29
5.3.15	Resistance against ageing.....	29
5.3.16	Wet leakage current test.....	29
5.3.17	Humidity freeze test.....	30
5.3.18	Bypass diode thermal test.....	30
5.3.19	Test of terminations and connection methods	31
5.3.20	Knock-out inlets (outlets) intended to be removed by mechanical impact	32
5.3.21	Test of cord anchorage	32
5.3.22	Retention on the mounting surface	34
5.3.23	Reverse current test at junction box.....	34
5.4	Test schedule	35
Annex A (informative)	Symbol "Do not disconnect under load"	45
Annex B (normative)	Qualification of conformal coatings for protection against pollution.....	46
B.1	General.....	46
B.2	Technical properties	46
B.3	Qualification of coatings.....	46
Annex C (normative)	Measurement of clearances and creepage distances	49
Bibliography		53
Figure 1	– Thermal cycling test – Temperature and applied current profile	40
Figure 2	– Humidity-freeze cycle.....	41
Figure 3	– Typical arrangement for the cable anchorage pull test.....	41
Figure 4	– Typical arrangement for torsion test	42
Figure 5	– Typical arrangement for flammability test in accordance with 5.3.12.2.....	42
Figure 6	– Measurement of voltage drop	43
Figure 7	– Bypass diode thermal test	43
Figure 8	– Proper attachment of 5 N weight to junction box.....	44
Figure A.1	– Symbol "DO NOT DISCONNECT UNDER LOAD"	45
Figure A.2	– Symbol "DO NOT DISCONNECT UNDER LOAD" (IEC 60417-6070:2011-06)....	45
Figure C.1	– Examples of methods of measuring clearances and creepage distances.....	52
Table 1	– Required type of insulation	18
Table 2	– Rated impulse voltages and minimum clearances.....	19
Table 3	– Creepage distances for basic insulation	20
Table 4	– Number of specimens.....	23
Table 5	– Values of torque for screw-type clamping units.....	24
Table 6	– Pull forces for cord anchorage.....	33

Table 7 – Values for torsion test	34
Table 8 – Marking, information, documentation, test group A	35
Table 9 – Material test, test group B (single tests)	36
Table 10 – Constructional requirements, test group C (single tests).....	37
Table 11 – Mechanical tests, test group D (single tests)	37
Table 12 – Test sequence I, test group E (tests to be performed consecutively in this order).....	38
Table 13 – Test sequence II, test group F (tests to be performed consecutively in this order).....	38
Table 14 – Test sequence III, test group G (tests to be performed consecutively in this order).....	39
Table 15 – Test sequence IV, test group H (tests to be performed consecutively in this order).....	39
Table 16 – Reverse current test, test group I	39
Table 17 – Test sequence V, test group J (tests to be performed consecutively in this order).....	40
Table B.1 – Test parameters, test conditions and test procedures.....	47
Table B.2 – Test sequence and conformity check (tests to be performed consecutively in this order)	48
Table C.1 – Dimensions of <i>X</i>	49

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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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 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 61140:2016, *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*

SOMMAIRE

AVANT-PROPOS	57
1 Domaine d'application	59
2 Références normatives	59
3 Termes et définitions	61
4 Exigences de construction et performances	66
4.1 Généralités	66
4.2 Marquage et identification	66
4.2.1 Identification	66
4.2.2 Marquage	67
4.2.3 Documentation technique	67
4.3 Protection contre les chocs électriques	67
4.4 Extrémités, dispositifs de connexion et méthodes de connexion	68
4.5 Connecteurs	69
4.6 Câbles	69
4.7 Résistance au vieillissement	69
4.8 Conception générale	69
4.9 Degré de protection (IP)	69
4.10 Rigidité diélectrique	70
4.11 Plage de température ambiante	70
4.12 Serre-câble	70
4.13 Résistance mécanique	70
4.14 Isolation	70
4.14.1 Type d'isolation	70
4.14.2 Isolation principale	71
4.14.3 Isolation supplémentaire	71
4.14.4 Double isolation	71
4.14.5 Isolation renforcée	71
4.15 Distances d'isolement et lignes de fuite	71
4.15.1 Distances d'isolement	71
4.15.2 Lignes de fuite	72
4.16 Parties isolantes	74
4.16.1 Parties extérieures accessibles	74
4.16.2 Parties internes maintenant les parties actives en place	74
4.17 Parties conductrices et résistance à la corrosion	74
4.18 Étanchéité	75
4.19 Diode de dérivation	75
4.20 Entrées (sorties) d'une ouverture défonçable destinées à être retirées par impact mécanique	75
5 Essais	75
5.1 Généralités	75
5.2 Préparation des éprouvettes	76
5.3 Réalisation des essais	78
5.3.1 Généralités	78
5.3.2 Durabilité du marquage	78
5.3.3 Fixation du couvercle sur une boîte de jonction démontable	78
5.3.4 Protection contre les chocs électriques	79

5.3.5	Mesure des distances d'isolement et des lignes de fuite	79
5.3.6	Rigidité diélectrique	79
5.3.7	Résistance à la corrosion	79
5.3.8	Résistance mécanique à des températures inférieures	80
5.3.9	Essai de cycle thermique (IEC 60068-2-14:2009, Essai Nb).....	80
5.3.10	Essai de chaleur humide.....	81
5.3.11	Essai de résistance aux intempéries	81
5.3.12	Classe d'inflammabilité	82
5.3.13	Essai à la bille	82
5.3.14	Essai au fil incandescent	82
5.3.15	Résistance au vieillissement.....	82
5.3.16	Essai de courant de fuite en milieu humide	82
5.3.17	Essai humidité-gel	83
5.3.18	Essai thermique de la diode de dérivation.....	84
5.3.19	Essai des extrémités et méthodes de connexion	85
5.3.20	Entrées (sorties) d'une ouverture défonçable destinées à être retirées par impact mécanique.....	85
5.3.21	Essai du serre-cordon.....	86
5.3.22	Maintien sur la surface de montage	88
5.3.23	Essai de courant inverse au niveau de la boîte de jonction	88
5.4	Programme d'essai	89
Annexe A (informative) Symbole "Ne pas débrancher sous charge"		100
Annexe B (normative) Qualification des revêtements enrobants pour la protection contre la pollution		101
B.1	Généralités	101
B.2	Propriétés techniques	101
B.3	Qualification des revêtements	101
Annexe C (normative) Mesurage des distances d'isolement et des lignes de fuite.....		104
Bibliographie.....		108
Figure 1 – Essai de cycle thermique – Température et profil de courant appliqué		95
Figure 2 – Cycle humidité-gel		95
Figure 3 – Exemple de montage d'essai de traction du serre-câble		96
Figure 4 – Exemple de montage d'essai de torsion		96
Figure 5 – Exemple de montage d'essai d'inflammabilité conformément à 5.3.12.2.....		97
Figure 6 – Mesurage de la chute de tension.....		97
Figure 7 – Essai thermique de la diode de dérivation		98
Figure 8 – Fixation appropriée d'une masse de 5 N à la boîte de jonction		99
Figure A.1 – Symbole "NE PAS DÉBRANCHER SOUS CHARGE"		100
Figure A.2 – Symbole "NE PAS DÉBRANCHER SOUS CHARGE" (IEC 60417- 6070:2011-06)		100
Figure C.1 – Exemples de méthodes de mesurage des distances d'isolement et lignes de fuite		107
Tableau 1 – Type d'isolation exigé.....		71
Tableau 2 – Tensions de choc assignées et distances d'isolement minimales.....		72
Tableau 3 – Lignes de fuite pour l'isolation principale		73

Tableau 4 – Nombre d'éprouvettes	76
Tableau 5 – Valeurs des couples pour les organes de serrage à vis	77
Tableau 6 – Forces de traction du serre-cordon	87
Tableau 7 – Valeurs de l'essai de torsion.....	87
Tableau 8 – Marquage, informations, documentation, groupe d'essais A.....	89
Tableau 9 – Essai de matériau, groupe d'essais B (essais uniques)	90
Tableau 10 – Exigences de construction, groupe d'essais C (essais uniques).....	91
Tableau 11 – Essais mécaniques, groupe d'essais D (essais uniques)	91
Tableau 12 – Séquence d'essais I, groupe d'essais E (essais à réaliser successivement dans cet ordre).....	92
Tableau 13 – Séquence d'essais II, groupe d'essais F (essais à réaliser successivement dans cet ordre).....	93
Tableau 14 – Séquence d'essais III, groupe d'essais G (essais à réaliser successivement dans cet ordre).....	93
Tableau 15 – Séquence d'essais IV, groupe d'essais H (essais à réaliser successivement dans cet ordre).....	94
Tableau 16 – Essai de courant inverse, groupe d'essais I	94
Tableau 17 – Séquence d'essais V, groupe d'essais J (essais à réaliser successivement dans cet ordre).....	94
Tableau B.1 – Paramètres d'essai, conditions d'essai et procédures d'essai.....	102
Tableau B.2 – Séquence d'essais et vérification de la conformité (essais à réaliser successivement dans cet ordre).....	103
Tableau C.1 – Dimensions de X	104

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**BOÎTES DE JONCTION POUR MODULES PHOTOVOLTAÏQUES –
EXIGENCES DE SÉCURITÉ ET ESSAIS****AVANT-PROPOS**

- 1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. À cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
- 2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
- 3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
- 4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
- 5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
- 6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
- 7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
- 8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
- 9) L'attention est attirée sur le fait que certains des éléments de la présente Publication de l'IEC peuvent faire l'objet de droits de brevet. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de brevets et de ne pas avoir signalé leur existence.

La Norme internationale IEC 62790 a été établie par le comité d'études 82 de l'IEC: Systèmes de conversion photovoltaïque de l'énergie solaire.

Cette deuxième édition annule et remplace la première édition parue en 2014. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) Modifications des références normatives et des termes et définitions;
- b) Amélioration de la catégorisation des boîtes de jonction en 4.1;
- c) Clarification de la température ambiante en 4.1;
- d) Ajout de l'exigence prévoyant de fournir les indices RTE/RTI ou IT en 4.2;
- e) Référence à l'IEC 62930 à la place de la référence à l'EN 50618 en 4.6;

- f) Ajout de "l'isolation fonctionnelle" dans le Tableau 1;
- g) Ajout de "ligne de fuite entre les bords du joint scellé" dans le Tableau 3;
- h) Correction de la procédure du processus de catégorisation des groupes de matériaux (suppression de l'ITC) au 4.15.2.3;
- i) Exigence d'approbation des indices RTE/RTI ou IT pour les parties isolantes en 4.16.1 et 4.16.2;
- j) Modification des exigences concernant le potentiel électrochimique en 4.17.2;
- k) Clarification des essais de vérification du code IP au 5.3.4.2;
- l) Ajout de la tension d'essai pour les joints scellés en 5.3.6 et 5.3.16;
- m) Ajout de la description détaillée sur la façon de préparer les éprouvettes pour l'essai de cycle thermique en 5.3.9.1;
- n) Nouvelle procédure d'essai pour l'essai thermique la diode de dérivation (5.3.18) conformément au MQT 18.1 de l'IEC 61215-2: 2016;
- o) Nouvelle procédure d'essai pour l'essai de courant de surcharge inverse au 5.3.23;
- p) Nouvelle Figure 1 pour l'essai de cycle thermique.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
82/1719/FDIS	82/1738/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

IMPORTANT – Le logo "*colour inside*" qui se trouve sur la page de couverture de cette publication indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.

BOÎTES DE JONCTION POUR MODULES PHOTOVOLTAÏQUES – EXIGENCES DE SÉCURITÉ ET ESSAIS

1 Domaine d'application

Le présent document décrit les exigences de sécurité, les exigences de construction et les essais relatifs aux boîtes de jonction jusqu'à 1 500 V en courant continu utilisées sur des modules photovoltaïques conformes à la classe II de l'IEC 61140:2016.

Le présent document s'applique également aux enveloppes montées sur des modules photovoltaïques comportant des circuits électroniques pour la conversion, le contrôle, la surveillance ou opérations similaires. Des exigences supplémentaires concernant les opérations correspondantes sont appliquées en considérant les conditions d'environnement des modules photovoltaïques. Le présent document ne s'applique pas aux circuits électroniques de ces dispositifs pour lesquels d'autres normes IEC s'appliquent.

NOTE Pour les boîtes de jonction conformes aux classes 0 et III de l'IEC 61140:2016 dans les systèmes photovoltaïques, le présent document peut être utilisé en référence.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60060-1, *Technique des essais à haute tension – Partie 1: Définitions et exigences générales*

IEC 60068-1, *Essais d'environnement – Partie 1: Généralités et lignes directrices*

IEC 60068-2-14:2009, *Essais d'environnement – Partie 2-14: Essais – Essai N: Variation de température*

IEC 60068-2-70, *Essais d'environnement – Partie 2-70: Essais – Essai Xb: Effacement des marquages et inscriptions par friction des doigts et des mains*

IEC 60068-2-75, *Essais d'environnement – Partie 2-75: Essais – Essai Eh: Essais au marteau*

IEC 60068-2-78, *Essais d'environnement – Partie 2-78: Essais – Essai Cab: Chaleur humide, essai continu*

IEC 60216-1, *Matériaux isolants électriques – Propriétés d'endurance thermique – Partie 1: Méthodes de vieillissement et évaluation des résultats d'essai*

IEC 60216-5, *Matériaux isolants électriques – Propriétés d'endurance thermique – Partie 5: Détermination de l'indice d'endurance thermique relatif (RTE) d'un matériau isolant*

IEC 60352-2, *Connexions sans soudure – Partie 2: Connexions serties – Exigences générales, méthodes d'essai et guide pratique*

IEC 60352-3, *Connexions sans soudure – Partie 3: Connexions autodénudantes accessibles sans soudure – Règles générales, méthodes d'essai et guide pratique*

IEC 60352-4, *Connexions sans soudure – Partie 4: Connexions autodénudantes non accessibles sans soudure – Règles générales, méthodes d'essai et guide pratique*

IEC 60352-5, *Connexions sans soudure – Partie 5: Connexions insérées à force – Exigences générales, méthodes d'essai et guide pratique*

IEC 60352-6, *Connexions sans soudure – Partie 6: Connexions à percement d'isolant – Règles générales, méthodes d'essai et guide pratique*

IEC 60352-7, *Connexions sans soudure – Partie 7: Connexions à ressort – Règles générales, méthodes d'essai et guide pratique*

IEC 60529, *Degrés de protection procurés par les enveloppes (code IP)*

IEC 60664-1:2007, *Coordination de l'isolement des matériels dans les systèmes (réseaux) à basse tension – Partie 1: Principes, exigences et essais*

IEC 60695-2-11, *Essais relatifs aux risques du feu – Partie 2-11: Essais au fil incandescent / chauffant – Méthode d'essai d'inflammabilité pour produits finis (GWEPT)*

IEC 60695-10-2, *Essais relatifs aux risques du feu – Partie 10-2: Chaleurs anormales – Essai à la bille*

IEC 60695-11-10, *Essais relatifs aux risques du feu – Partie 11-10: Flammes d'essai – Méthodes d'essai horizontal et vertical à la flamme de 50 W*

IEC 60695-11-20, *Essais relatifs aux risques du feu – Partie 11-20: Flammes d'essai – Méthodes d'essai à la flamme de 500 W*

IEC 60947-7-1, *Appareillage à basse tension – Partie 7-1: Matériels accessoires – Blocs de jonction pour conducteurs en cuivre*

IEC 60998-2-3, *Dispositifs de connexion pour circuits basse tension pour usage domestique et analogue – Partie 2-3: Règles particulières pour dispositifs de connexion en tant que parties séparées avec organes de serrage à perçage d'isolant*

IEC 60999-1:1999, *Dispositifs de connexion – Conducteurs électriques en cuivre – Prescriptions de sécurité pour organes de serrage à vis et sans vis – Partie 1: Prescriptions générales et particulières pour les organes de serrage pour les conducteurs de 0,2 mm² à 35 mm² (inclus)*

IEC 60999-2, *Dispositifs de connexion – Conducteurs électriques en cuivre – Prescriptions de sécurité pour organes de serrage à vis et sans vis – Partie 2: Prescriptions particulières pour les organes de serrage pour conducteurs au-dessus de 35 mm² et jusqu'à 300 mm² (inclus)*

IEC 61032, *Protection des personnes et des matériels par les enveloppes – Calibres d'essai pour la vérification*

IEC 61140:2016, *Protection contre les chocs électriques – Aspects communs aux installations et aux matériels*

IEC 61191-1, *Ensembles de cartes imprimées – Partie 1: Spécification générique – Exigences relatives aux ensembles électriques et électroniques brasés utilisant les techniques de montage en surface et associées*

IEC 61210, *Dispositifs de connexion – Bornes plates à connexion rapide pour conducteurs électriques en cuivre – Exigences de sécurité*

IEC 61215-1:2016, *Modules photovoltaïques (PV) pour applications terrestres – Qualification de la conception et homologation – Partie 1: Exigences d'essai*

IEC 61215-2:2016, *Modules photovoltaïques (PV) pour applications terrestres – Qualification de la conception et homologation – Partie 2: Procédures d'essai*

IEC 61730-1:2016, *Qualification pour la sûreté de fonctionnement des modules photovoltaïques (PV) – Partie 1: Exigences pour la construction*

IEC 62852, *Connecteurs pour applications en courant continu pour systèmes photovoltaïques – Exigences de sécurité et essais*

IEC 62930, *Electric cables for photovoltaic systems with a voltage rating of 1,5 kV DC* (disponible en anglais seulement)

ISO 868:2003, *Plastiques et ébonite – Détermination de la dureté par pénétration au moyen d'un duromètre (dureté Shore)*

ISO 4892-2, *Plastiques – Méthodes d'exposition à des sources lumineuses de laboratoire – Partie 2: Lampes à arc au Xénon*

ISO 4892-3, *Plastiques – Méthodes d'exposition à des sources lumineuses de laboratoire – Partie 3: Lampes fluorescentes UV*