ICS 27.160 SLOVENSKÁ TECHNICKÁ NORMA December 2023

STN	**Meracie postupy na materiály používané vo fotovoltických moduloch Časť 2-1: Polymérne materiály Predná a zadná doska Požiadavky na bezpečnosť**	**STN EN IEC 62788-2-1 36 4605**

Measurement procedures for materials used in photovoltaic modules - Part 2-1: Polymeric materials - Frontsheet and backsheet - Safety requirements

Táto norma obsahuje anglickú verziu európskej normy.
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 11/23

Obsahuje: EN IEC 62788-2-1:2023, IEC 62788-2-1:2023

obsahuje farebné strany

137750

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 62788-2-1

October 2023

ICS 27.160

English Version

Measurement procedures for materials used in photovoltaic modules - Part 2-1: Polymeric materials - Frontsheet and backsheet - Safety requirements (IEC 62788-2-1:2023)

Procédures de mesure des matériaux utilisés dans les modules photovoltaïques - Partie 2-1: Matériaux polymères - Face avant et face arrière - Exigences de sécurité (IEC 62788-2-1:2023)

Messverfahren für Werkstoffe, die in Photovoltaik-Modulen verwendet werden - Teil 2-1: Polymerwerkstoffe - Frontsheets und Backsheets - Sicherheitsanforderungen (IEC 62788-2-1:2023)

This European Standard was approved by CENELEC on 2023-09-29. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 82/2123/FDIS, future edition 1 of IEC 62788-2-1, prepared by IEC/TC 82 "Solar photovoltaic energy systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62788-2-1:2023.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2024-06-29
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2026-09-29

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 62788-2-1:2023 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 60112:2020 NOTE Approved as EN IEC 60112:2020 (not modified)

IEC 62941:2019 NOTE Approved as EN IEC 62941:2020 (not modified)

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 60216-1	-	Electrical insulating materials - Thermal endurance properties - Part 1: Ageing procedures and evaluation of test results	EN 60216-1	-
IEC 60216-3	-	Electrical insulating materials - Thermal endurance properties - Part 3: Instructions for calculating thermal endurance characteristics	EN IEC 60216-3	-
IEC 60216-5	-	Electrical insulating materials - Thermal endurance properties - Part 5: Determination of relative temperature index (RTI) of an insulating material	EN IEC 60216-5	-
IEC 60664-1	-	Insulation coordination for equipment within low-voltage supply systems - Part 1: Principles, requirements and tests	EN IEC 60664-1	-
IEC 61215-1	-	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements	EN IEC 61215-1	-
IEC 61215-2	-	Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 2: Test procedures	EN IEC 61215-2	-
IEC 61730-1	-	Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction	EN IEC 61730-1	-
IEC 61730-2	-	Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing	EN IEC 61730-2	-
IEC/TS 61836	-	Solar photovoltaic energy systems - Terms, definitions and symbols	-	-
IEC TS 62788-2	-	Measurement procedures for materials used in photovoltaic modules - Part 2: Polymeric materials - Frontsheets and backsheets	-	-

EN IEC 62788-2-1:2023 (E)

IEC/TS 62915	-	Photovoltaic (PV) modules - Type approval, design and safety qualification - Retesting	-	-
IEC TS 63126	2020	Guidelines for qualifying PV modules, components and materials for operation at high temperatures	-	-
ISO 527-3	-	Plastics - Determination of tensile properties - Part 3: Test conditions for films and sheets	EN ISO 527-3	-

IEC 62788-2-1

Edition 1.0 2023-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Measurement procedures for materials used in photovoltaic modules – Part 2-1: Polymeric materials – Frontsheet and backsheet – Safety requirements

Procédures de mesure des matériaux utilisés dans les modules photovoltaïques – Partie 2-1: Matériaux polymères – Face avant et face arrière – Exigences de sécurité

IEC 62788-2-1:2023-08(en-fr)

IEC 62788-2-1

Edition 1.0 2023-08

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Measurement procedures for materials used in photovoltaic modules – Part 2-1: Polymeric materials – Frontsheet and backsheet – Safety requirements

Procédures de mesure des matériaux utilisés dans les modules photovoltaïques – Partie 2-1: Matériaux polymères – Face avant et face arrière – Exigences de sécurité

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 27.160

ISBN 978-2-8322-6887-2

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

MEASUREMENT PROCEDURES FOR MATERIALS USED IN PHOTOVOLTAIC MODULES –

Part 2-1: Polymeric materials – Frontsheet and backsheet – Safety requirements

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 because 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.

IEC 62788-2-1 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is an International Standard.

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

Draft	Report on voting
82/2123/FDIS	82/2148/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 62788 series, published under the general title *Measurement procedures for materials used in photovoltaic modules*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under 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 document 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.

INTRODUCTION

This document provides test procedures and specifications for polymeric front- and backsheet constructions employed in a PV module for safety qualification on a component level. Test methods have been compiled to match the general requirements for polymeric materials used as relied-upon insulation defined in the IEC 61730 standard series in consideration of test methods in IEC TS 62788-2 (characterization of front- and backsheets), IEC TS 62788-7-2 [4][1](UV weathering test) and the retesting guidelines IEC TS 62915. This document provides clarifications on definitions of front- and backsheet construction types and related test requirements, and additional environmental stress testing, to which IEC 61730-1 refers. Separating out the component level testing into this document was considered to limit the complexity of the IEC 61730 standard series, also in view of the implementation of the test methods in the frame of IEC System of Conformity Assessment Schemes for Electrotechnical Equipment and Components (IECEE).

Test methods on a component level and PV module level are different for practical reasons. On a component level, the daylight filtered xenon test (IEC TS 62788-7-2) is applied for UV weathering, which is regarded as more representative to assess the durability of polymeric materials under outdoor weather conditions than the UVA test of IEC 61215-2. The latter has been developed in view of practicality of applying UV exposure to larger scale PV modules.

This document focusses on the safety relevant properties of front- and backsheets as required by IEC 61730.

The lamination protrusion test (aka DTI test) is required to measure the thickness of relied-upon insulation on the component level. The thickness of the RUI layer(s) is verified by MST 04 of IEC 61730-2 on PV module level. The test provides additional information needed for evaluation of the Comparative Tracking Index (CTI) and dielectric strength / breakdown voltage.

– The lamination protrusion test applies default lamination conditions, that are representative for a typical PV module manufacturing process. Using a 800 μm diameter solder wire that mimics severe solder peaks and/or slanted ribbons, the test serves as worst case scenario for measurement of potential displacement of material under lamination conditions. Even more harsh lamination process conditions can be selected as recommended by the manufacturer of the front- or backsheet.
– The lamination protrusion test is also used to identify additional inner layers of the front- or backsheet that potentially may be in contact with live parts and for which CTI shall be determined. Additional layers may require CTI depending on the construction of the PV module, e.g., due to specific sheet openings and through wiring for junction box connections with background provided in IEC 61730-1.
– The ratio of the measured distance through insulation (t_{DTI}) to the total thickness is used to calculate the effective dielectric strength or required withstand voltage when measured on final products that contain inner layers, which can be displaced under lamination conditions (see breakdown voltage test in 6.4).
– Because of the relationship with thermal endurance, t_{DTI} can be listed as a function of the module operating temperature rating.

[1] Numbers in square brackets refer to the Bibliography.

This document specifies a suite of environmental stress tests to characterize the durability of the relied-upon insulation. In the evaluation of tensile testing a minimum elongation at break is considered in addition to retention of tensile strength, as this allows to differentiate known-bad and known-good materials. The thermal endurance performance, which is historically evaluated by tensile strength and dielectric strength in terms of TI or RTE (RTI), is therefore complemented by a thermal failsafe test to also evaluate elongation at break. The combination of these elements, tests covering thermal, damp heat and UV weathering stresses and evaluation of elongation at break, represents a step forward in safety testing of polymeric front- and backsheets that is still balanced in terms or practicality (duration) of testing.

The requirements in this document for model or variant designations and (re)testing of similar materials have been aligned with developments for the IEC TS 62915 module retesting guidelines. The current requirements provide a first step towards more detailed requirements which may be developed in a future revision of this document or a dedicated component retesting standard.

A future revision of this document may consider sequential testing on engineering coupons with (solder wire) bumps to better mimic the combination of UV and cyclic stress fatigue, that is currently discussed as the next level in endurance testing of polymeric front- and backsheets in IEC TS 62788-2 and IEC TS 63209-2[6]. However, method consolidation requires more time than available for this project.

In view of requirements for material identification in the context of the retesting guidelines (IEC TS 62915), approaches for “finger-printing” are provided in Annex A.

The requirements in this document may be used in the context of Manufacturing Quality Assurance of polymeric front- and backsheets as explained in the guideline IEC 62941[5].

MEASUREMENT PROCEDURES FOR MATERIALS USED IN PHOTOVOLTAIC MODULES –

Part 2-1: Polymeric materials – Frontsheet and backsheet – Safety requirements

1 Scope

This document specifies the safety requirements for flexible polymeric front- and backsheet constructions, which are intended for use as relied-upon insulation in photovoltaic (PV) modules. The specifications in this document define the specific requirements of polymeric front- or backsheet constructions on the component level and cover mechanical, electrical, visual and thermal characterization in an unexposed state and/or after ageing.

This document covers class II and class 0 modules, as defined in IEC 61730-1. Class III modules are out of scope.

For qualification to IEC 61730-1 of a PV module using a polymeric front- or backsheet, the sheet must pass the requirements in this document for the specified module's safety class, rated system voltage, and module temperature rating.

Compliance with the safety requirements for a front- or backsheet on the component level does not replace the need for a safety qualification of the complete PV module, in which the front- or backsheet is integrated. The appropriate requirements for testing and qualification of PV modules, are defined in IEC 61730-1 and IEC 61215-1 (or IEC TS 62915 in case of retesting), with test methods provided by IEC 61730-2 and IEC 61215-2, respectively.

This document provides the requirements for qualification of front- and backsheets to be used in module safety qualification according to IEC 61730-1. Test method descriptions are provided in IEC TS 62788-2, along with additional characterization methods useful for performance or quality assurance.

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

IEC 60216-3, *Electrical insulating materials – Thermal endurance properties – Part 3: Instructions for calculating thermal endurance characteristics*

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

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

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

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

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

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

IEC TS 61836, *Solar photovoltaic energy systems – Terms, definitions and symbols*

IEC TS 62788-2, *Measurement procedures for materials used in photovoltaic modules – Part 2: Polymeric materials – Frontsheets and backsheets*

IEC TS 62915, *Photovoltaic (PV) modules – Type approval, design and safety qualification – Retesting*

IEC TS 63126:2020, *Guidelines for qualifying PV modules, components and materials for operation at high temperatures*

ISO 527-3, *Plastics – Determination of tensile properties – Part 3: Test conditions for films and sheets*