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Interested committees:

Title: Draft BS EN IEC 62788-1-1 Measurement procedures for materials used in photovoltaic modules. Part 1-1: Encapsulants – Polymeric materials used for encapsulants.

Please notify the secretary if you are aware of any keywords that might assist in classifying or identifying the standard or if the content of this standard

- i) has any issues related to 3rd party IPR, patent or copyright
- ii) affects other national standard(s)
- iii) requires additional national guidance or information

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



82/1655/CD

COMMITTEE DRAFT (CD)

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IEC 62788-1-1 ED1

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CLOSING DATE FOR COMMENTS:

2020-01-31

SUPERSEDES DOCUMENTS:

82/1525/NP, 82/1600A/RVN

IEC TC 82 : SOLAR PHOTOVOLTAIC ENERGY SYSTEMS

SECRETARIAT:

United States of America

SECRETARY:

Mr George Kelly

OF INTEREST TO THE FOLLOWING COMMITTEES:

PROPOSED HORIZONTAL STANDARD:



Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.

FUNCTIONS CONCERNED:

☐ EMC

☐ ENVIRONMENT

☒ QUALITY ASSURANCE

☐ SAFETY

This document is still under study and subject to change. It should not be used for reference purposes.

Recipients of this document are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

TITLE:

Measurement procedures for materials used in photovoltaic modules – Part 1-1: Encapsulants – Polymeric materials used for encapsulants

NOTE FROM TC/SC OFFICERS:

This project was discussed and supported by WG2 during their meeting in Mississauga 2019-10.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MATERIALS USED IN PHOTOVOLTAIC MODULES –
MEASUREMENT PROCEDURES –****Part 1: Encapsulants –****Part 1-1: Polymeric materials used for encapsulants**

FOREWORD

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

The text of this standard is based on the following documents:

NWP	Report on voting
82/XX/NP	82/XX/RVD

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

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

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

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

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

The National Committees are requested to note that for this publication the stability date is TBD.

THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

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.

MATERIALS USED IN PHOTOVOLTAIC MODULES – MEASUREMENT PROCEDURES –

Part 1: Encapsulants –

Part -1: Polymeric materials used for encapsulants

1 Scope

The encapsulant fulfils the purposes of: optically coupling the cell to external radiation; mechanically attaching and holding module components in their relative positions; electrically isolating module components; thermally coupling module components; and chemically protecting module components (e.g., by limiting the concentration and transport of water and/or oxygen). This document defines test methods and reporting requirements for characteristics (optical, mechanical, electrical, thermal, and chemical) of non-rigid polymeric materials, e.g., poly(ethylene-co-vinyl acetate) or “EVA”, intended for use in terrestrial photovoltaic modules as polymeric encapsulants.

Encapsulants are considered functional insulators, i.e., they provide electrical insulation when present, but are not considered Relied on Insulators. Requirements related to Relied on Insulators are identified in IEC 61730-1 and IEC TS 62788-2-1.

The test methods in this document define how to characterize encapsulant materials in a manner representative of relevant to how they will be used in the module, which eventually includes combination with other components such as frontsheets, backsheets, adhesives, edge seals, or glass. The methods described in this document support and supplement the safety and performance related tests defined on PV module level as defined in IEC 61730-2 and IEC 61215-1. The standard also defines test methods for general assessment of material characteristics of polymeric encapsulants.

The test methods described in this document may be used for the purposes of: datasheet reporting (aiding module design or material research and development); process- and manufacturing-control (e.g., incoming or outgoing inspection); application in module safety and design-type-qualification protocols; reliability and durability standards/study; or failure analysis.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60112, *Method for the determination of the proof and the comparative tracking indices of solid insulating materials*

IEC 60695-2-10, *Fire hazard testing - Part 2-10: Glowing/hot-wire based test methods - Glow-wire apparatus and common test procedure*

IEC 60695-2-20, *Fire hazard testing - Part 2-20: Glowing/hot wire based test methods - Hot-wire coil ignitability - Apparatus, test method and guidance*

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

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

- 50 IEC 61215-2, Terrestrial photovoltaic (PV) modules - Design qualification and type approval -
51 Part 2: Test procedures
- 52 IEC 61730-1, *Photovoltaic (PV) module safety qualification - Part 1: Requirements for*
53 *construction*
- 54 IEC 61730-2, *Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing*
- 55 IEC TS 61836: 2016, *Solar photovoltaic energy systems – Terms, definitions and symbols*
- 56 IEC 62788-1-2, *Measurement procedures for materials used in photovoltaic modules -*
57 *Encapsulants - Part 1-2: - Measurement of volume resistivity of photovoltaic encapsulants and*
58 *other polymeric materials*
- 59 IEC 62788-1-4, *Measurement procedures for materials used in photovoltaic modules -*
60 *Encapsulants - Part 1-4: - Measurement of optical transmittance and calculation of the solar-*
61 *weighted photon transmittance, yellowness index, and UV cut-off wavelength*
- 62 IEC 62788-1-5, *Measurement procedures for materials used in photovoltaic modules -*
63 *Encapsulants - Part 1-5: Measurement of change in linear dimensions of sheet encapsulation*
64 *material resulting from applied thermal conditions*
- 65 IEC 62788-1-6, *Measurement procedures for materials used in photovoltaic modules -*
66 *Encapsulants - Part 1-6: Test methods for determining the degree of cure in Ethylene-Vinyl*
67 *Acetate*
- 68 IEC 62788-1-7, *Measurement procedures for materials used in photovoltaic modules - Part 1-*
69 *7: Optical durability of transparent polymeric PV packaging materials – Test procedure*
- 70 IEC TS 62788-2, *Measurement procedures for materials used in photovoltaic modules - Part 2:*
71 *Polymeric materials used for frontsheets and backsheets*
- 72 IEC 62788-2-1, *Polymeric materials for photovoltaic (PV) modules – Part 2-1: Safety*
73 *requirements for polymeric frontsheet and backsheet*
- 74 IEC 62788-6-2, *Measurement procedures for materials used in photovoltaic modules – Part 6-*
75 *2: General tests – 2 Moisture permeation testing with polymeric films*
- 76 IEC 62788-6-3, *Measurement procedures for materials used in photovoltaic modules – Part 6-*
77 *3: Adhesion testing of interfaces within PV modules*
- 78 IEC TS 62788-7-2: *Measurement procedures for materials used in photovoltaic modules - Part*
79 *7-2: Environmental exposures - Accelerated weathering tests of polymeric materials*
- 80 IEC 62790, *Junction boxes for photovoltaic modules - Safety requirements and tests*
- 81 IEC 62941, *Terrestrial photovoltaic (PV) modules - Guideline for increased confidence in PV*
82 *module design qualification and type approval*
- 83 ISO 62, *Plastics -- Determination of water absorption*
- 84 ISO 489, *Plastics -- Determination of refractive index*
- 85 ISO 536, *Paper and board -- Determination of grammage*
- 86 ISO 1133-1, *Plastics -- Determination of the melt mass-flow rate (MFR) and melt volume-flow*
87 *rate (MVR) of thermoplastics -- Part 1: Standard method*
- 88 ISO 1183-1, *Plastics -- Methods for determining the density of non-cellular plastics -- Part 1:*
89 *Immersion method, liquid pycnometer method and titration method*
- 90 ISO 1183-2, *Plastics -- Methods for determining the density of non-cellular plastics -- Part 2:*
91 *Density gradient column method*

- 92 ISO 4593, *Plastics -- Film and sheeting -- Determination of thickness by mechanical scanning*
- 93 ISO 5657, *Reaction to fire tests -- Ignitability of building products using a radiant heat source*
- 94 ISO 6721-1, *Plastics -- Determination of dynamic mechanical properties -- Part 1: General*
95 *principles*
- 96 ISO 6721-4, *Plastics -- Determination of dynamic mechanical properties -- Part 4: Tensile*
97 *vibration -- Non-resonance method*
- 98 ISO 7619-1, *Rubber, vulcanized or thermoplastic -- Determination of indentation hardness --*
99 *Part 1: Durometer method (Shore hardness)*
- 100 ISO 8510-2, *Adhesives -- Peel test for a flexible-bonded-to-rigid test specimen assembly -- Part*
101 *2: 180 degree peel*
- 102 ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*
- 103 ISO 11357-1, *Plastics -- Differential scanning calorimetry (DSC) -- Part 1: General principles*
- 104 ISO 11357-2, *Plastics -- Differential scanning calorimetry (DSC) -- Part 2: Determination of*
105 *glass transition temperature and glass transition step height*
- 106 ISO 11357-3, *Plastics -- Differential scanning calorimetry (DSC) -- Part 3: Determination of*
107 *temperature and enthalpy of melting and crystallization*
- 108 ISO 11358-1, *Plastics -- Thermogravimetry (TG) of polymers -- Part 1: General principles*
- 109 ISO 11359-1, *Plastics -- Thermomechanical analysis (TMA) -- Part 1: General principles*
- 110 ISO 11359-2, *Plastics -- Thermomechanical analysis (TMA) -- Part 2: Determination of*
111 *coefficient of linear thermal expansion and glass transition temperature*
- 112 ISO 11502, *Plastics -- Film and sheeting -- Determination of blocking resistance*
- 113 ISO 15106-2, *Plastics -- Film and sheeting -- Determination of water vapour transmission rate*
114 *-- Part 2: Infrared detection sensor method*
- 115 ISO 15106-3, *Plastics -- Film and sheeting -- Determination of water vapour transmission rate*
116 *-- Part 3: Electrolytic detection sensor method*
- 117 ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*
- 118 ISO 18898, *Rubber -- Calibration and verification of hardness testers*
- 119 ISO 20501, *Fine ceramics (advanced ceramics, advanced technical ceramics) -- Weibull*
120 *statistics for strength data*
- 121 ISO 22007-4, *Plastics -- Determination of thermal conductivity and thermal diffusivity -- Part 4:*
122 *Laser flash method*
- 123 ASTM C1239, *Standard Practice for Reporting Uniaxial Strength Data and Estimating Weibull*
124 *Distribution Parameters for Advanced Ceramics*
- 125 ASTM D2240, *Standard Test Method for Rubber Property—Durometer Hardness*
- 126 ASTM D3418, *Standard Test Method for Transition Temperatures and Enthalpies of Fusion and*
127 *Crystallization of Polymers by Differential Scanning Calorimetry*
- 128 ASTM D6988, *Standard Guide for Determination of Thickness of Plastic Film Test Specimens*
- 129 UL 746A, *Standard for Polymeric Materials - Short Term Property Evaluations*

3 Terms and definitions

For the purposes of this document, the following terms and definitions in IEC TS 61836 and the following apply:

3.1 Adhesive failure

De-bonding occurring between the adhesive and the adherent, which is different from cohesive failure within the adhesive material

3.2 Cohesive failure

Failure by fracture, with crack propagation through the bulk of a material.

3.3 Encapsulant

The material used between the substrate and superstrate to provide environmental protection for photovoltaic cells in a photovoltaic module. See IEC 61836.

3.4 Fickian

Within the experimental uncertainty, the diffusivity is constant, independent of concentration. See IEC 62788-6-2.

3.5 Junction box (J-Box)

Combination of parts, such as boxes, covers, cover-plates, lids, box extensions, and accessories providing after assembly and installation on the photovoltaic module as in normal use, an appropriate protection against external influences, and a defined protection against contact with enclosed live parts from any accessible direction. See IEC 62790.

3.6 Optional test

A test which is not required to be performed (e.g., for datasheet reporting) but may also be performed.

3.7 Polymeric material

Materials that are either natural or synthetic and are primarily composed of chained molecules of monomers, combinations of monomers, combined polymers and may contain cross-linking agents, fillers, colorants, and other additives.

3.8 Relied upon insulation (RUI)

The insulation system that provides the protection against electric shock in final application as defined in IEC 61730-1 and IEC TS 62788-2-1.

3.9 Required test

A test which is required to be performed (e.g., for datasheet reporting) including module certification.

3.10 Storage modulus

The real part of the complex modulus, as defined in ISO 6721-1.

3.11 Substrate (“backsheet”, BS)

The outer surface material(s) on the back side of a photovoltaic module. See IEC 61836.

3.12 Superstrate (“frontsheet”, FS)

The (combination of) outer layer(s) of the PV module, located on the front of PV module and providing protection of the inner components of the PV module from external stresses and weather elements, as well as electrical insulation. See IEC 61730-1.

3.13 Water vapour transmission rate (WVTR)

The rate of water vapour transport through the material per unit area induced by a unit vapour pressure difference under specified temperature and humidity conditions.

4 Principle

The following test procedures shall be used to assess the optical, mechanical, electrical, thermal, and chemical characteristics of polymeric materials intended for use in terrestrial photovoltaic modules as polymeric encapsulants.

The universal characterization form (UCF) provides a standardized comprehensive reporting of characteristics often considered for encapsulants, including those found in the datasheet. For the purpose of the UCF, it is a required test that the characteristics identified in Table 1 of this document (“✓”) shall be characterized as described in this standard. The UCF and its requirements are described in Clause 6 in this document.

For the purpose of datasheet reporting, it is a required test that the characteristics identified in Table 1 of this document (“✓”) shall be characterized as described in this standard. Additional optional characteristics are identified in Table 1 (“O”) that may be helpful towards the use of encapsulants in PV technology. Characteristics that are not recommended for use in datasheet reporting are indicated in Table 1 (“–”).

Some characteristics that are most frequently used for the purposes of process- or manufacturing-control are identified in Table 1 of this document (“✓”). Additional characteristics are identified in Table 1 (“O”) that may also be used for encapsulants in PV technology. The use of these methods is presently considered an optional test. Most characteristics in Table 1 are typically not used for the process- or manufacturing-control of encapsulants as indicated in Table 1 (“–”). The methods identified here as required or optional are intended to aid the use of IEC 62941. The use of characteristics for process- or manufacturing-control is not required in IEC 62788-1-1. Rather, those characteristics that are identified by manufacturers to fulfil IEC 62941 shall be considered a required test; any additional characteristics shall be considered on optional test.

Some characteristics are more readily affected by weathering. Critical characteristics that shall be examined in conjunction with accelerated aging are identified in Table 1 of this document (“✓”). Most characteristics are typically not used with weathering of encapsulants, as indicated in Table 1 (“–”). The examination of optical transmittance & UV cutoff wavelength for the weathering of encapsulant according to IEC 62788-1-7 as well as the durability of encapsulant adhesion to accelerated testing is required for this standard; the results of the test shall be reported in the encapsulant datasheet.

Some characteristics may prove helpful to the failure analysis of weathered specimens or veteran modules. The most critical characteristics that may be examined for the purpose of failure analysis are identified in Table 1 of this document (“O”). The use of these methods is presently considered an optional test. Most characteristics are typically not used with failure analysis of encapsulants, as indicated in Table 1 (“–”).