Irish Standard
I.S. EN 62788-1-2:2016

Measurement procedures for materials used in photovoltaic modules - Part 1-2: Encapsulants - Measurement of volume resistivity of photovoltaic encapsulants and other polymeric materials

I.S. EN 62788-1-2:2016

Incorporating amendments/corrigenda/National Annexes issued since publication:

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This document is based on:	*Published:*
EN 62788-1-2:2016	2016-06-24

This document was published under the authority of the NSAI and comes into effect on:	ICS number:
2016-07-12	27.160
	NOTE: If blank see CEN/CENELEC cover page

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National Foreword

I.S. EN 62788-1-2:2016 is the adopted Irish version of the European Document EN 62788-1-2:2016, Measurement procedures for materials used in photovoltaic modules - Part 1-2: Encapsulants - Measurement of volume resistivity of photovoltaic encapsulants and other polymeric materials

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 62788-1-2

June 2016

ICS 27.160

English Version

Measurement procedures for materials used in photovoltaic modules - Part 1-2: Encapsulants - Measurement of volume resistivity of photovoltaic encapsulants and other polymeric materials (IEC 62788-1-2:2016)

Procédures de mesure des matériaux utilisés dans les modules photovoltaïques - Partie 1-2: Encapsulants - Mesurage de la résistivité transversale des encapsulants photovoltaïques et autres matériaux polymères (IEC 62788-1-2:2016)

Messverfahren für Werkstoffe, die in Photovoltaikmodulen verwendet werden - Teil 1-2: Verkapselungsstoffe - Messung des spezifischen Durchgangswiderstandes von Verkapselungsstoffen und Rückseitenfolien von Photovoltaikmodulen (IEC 62788-1-2:2016)

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Comité Européen de Normalisation Electrotechnique
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European foreword

The text of document 82/1085/FDIS, future edition 1 of IEC 62788-1-2, prepared by IEC/TC 82 “Solar photovoltaic energy systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62788-1-2:2016.

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)	2017-03-16
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2019-06-16

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Annex ZA
(normative)
Normative references to international publications with their corresponding European publications

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.

NOTE 1 When 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.cenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 61340-2-3	2000	Electrostatics -- Part 2-3: Methods of test for determining the resistance and resistivity of solid planar materials used to avoid electrostatic charge accumulation	EN 61340-2-3	2000
IEC 62631-3-2	2015	Dielectric and resistive properties of solid insulating materials - Part 3-2 Determination of resistive properties (DC Methods) - Surface resistance and surface resistivity	EN 62631-3-2	2016
ISO/IEC 17025	-	General requirements for the competence of testing and calibration laboratories	-	-
ASTM D 257-14	-	Standard Test Methods for DC Resistance or Conductance of Insulating Materials	-	-

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IEC 62788-1-2

Edition 1.0 2016-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Measurement procedures for materials used in photovoltaic modules – Part 1-2: Encapsulants – Measurement of volume resistivity of photovoltaic encapsulants and other polymeric materials

Procédures de mesure des matériaux utilisés dans les modules photovoltaïques – Partie 1-2: Encapsulants – Mesurage de la résistivité transversale des encapsulants photovoltaïques et autres matériaux polymères

IEC 62788-1-2:2016-05(en-fr)

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IEC 62788-1-2

Edition 1.0 2016-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Measurement procedures for materials used in photovoltaic modules – Part 1-2: Encapsulants – Measurement of volume resistivity of photovoltaic encapsulants and other polymeric materials

Procédures de mesure des matériaux utilisés dans les modules photovoltaïques – Partie 1-2: Encapsulants – Mesurage de la résistivité transversale des encapsulants photovoltaïques et autres matériaux polymères

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 27.160

ISBN 978-2-8322-3349-8

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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MEASUREMENT PROCEDURES FOR MATERIALS USED IN PHOTOVOLTAIC MODULES –

Part 1-2: Encapsulants – Measurement of volume resistivity of photovoltaic encapsulants and other polymeric materials

FOREWORD

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

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

FDIS	Report on voting
82/1085/FDIS	82/1105/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 *Measurement procedures for materials used in photovoltaic modules*, 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.

MEASUREMENT PROCEDURES FOR MATERIALS USED IN PHOTOVOLTAIC MODULES –

Part 1-2: Encapsulants – Measurement of volume resistivity of photovoltaic encapsulants and other polymeric materials

1 Scope

This part of IEC 62788 provides a method and guidelines for measuring the volume resistivity of materials used as encapsulation, edge seals, front-sheets, backsheets, or any other insulating material in a photovoltaic (PV) module. The test is performed on dry, humid or wet preconditioned samples. In the case of frontsheets and backsheets comprised of multiple layers, the measured resistivity is an effective value. This test is designed for room temperature measurement, but can also be utilized at higher temperatures.

Degradation of PV modules is known to occur in part by electrochemical corrosion, and other potential induced degradation processes. These processes may be dependent upon the resistivity of a polymeric component. Therefore, the DC resistivity of polymeric components is relevant to module design and durability in the field. The resistivity may depend on cure state, temperature, water content, and voltage history. A number of options are included to allow the measurement to be performed in a manner consistent with representative fielded module conditions.

Most resistivity measurement methods and equipment typically become inaccurate and variable for materials with volume resistivity above 10^{16} Ω·cm [5][1].Therefore, this standard is used for measurements less than $1 \cdot 10^{17}$ Ω·cm.

Both monolithic and multilayer materials (e.g. frontsheets and backsheets) are suitable for measurement. Methods are described for room temperature measurement, with guidelines included for testing at elevated temperatures.

Results will vary with moisture content, therefore materials should be tested in a manner anticipatory of usage. Preconditioning procedures for dry, humid and wet environments are included.

Depending on the material, voltage history will affect the measured result. The rate of change of current, and time to equilibrium varies with material often taking hours or days to come to a static level. For this reason, long and short duration methods are included (Methods A and B). The specified short-duration alternating polarity Method B is intended for qualitative comparison. Method A, long-duration on/off polarity, is recommended for characterization with regard to PID resistance.

Measurements obtained using either method may be used by material manufacturers for the purpose of quality control of their electrical insulating material as well as for reporting in product datasheets. PV module manufacturers may use these methods for the purpose of material acceptance, material selection, process development, design analysis, or failure analysis.

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1 Numbers in square brackets refer to the Bibliography.

This measurement method can also be utilized to monitor the performance of electrical insulating materials after weathering, to assess their durability.

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 61340-2-3:2000, *Electrostatics – Part 2-3: Methods for test for determining the resistance and resistivity of solid planar materials used to avoid electrostatic charge accumulation*

IEC 62631-3-2:2015, *Dielectric and resistive properties of solid insulating materials – Part 3-2: Determination of resistive properties (DC methods) – Surface resistance and surface resistivity*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

ASTM D 257-14, *Standard Test Methods for DC Resistance or Conductance of Insulating Materials*

3 Sampling

Thin polymer films or laminates (< 2 mm thick) shall be used as test samples. A thickness of 0,5 mm is presently typical in PV encapsulant and edge seal applications and is the suggested thickness to be used in this standard for those materials. Thickness should not vary more than 10 % across the sample. For backsheet or front-sheet materials, the specimens should be in the form and thickness supplied by the manufacturer, typically between 0,15 mm and 0,30 mm. Samples should be cured, or processed as would be typical for that material, (if applicable) according to the manufacturer's specification. Sample surfaces should be smooth which may require curing (or thermal treatment) while being held between flat, planar surfaces.

Encapsulants may optionally be laminated on one side to a metal foil to substitute for the second larger electrode in the test apparatus. In particular, the laminated foil (***e.g.*** Al, Cu, stainless steel, or other metals) may improve the handling of a soft gel material. Measurements will be made using 5 replicates for each measurement. To prevent spurious results from effects such as sample charging, samples should be measured only once and discarded.

4 Apparatus

Use two flat metal plate electrodes (Electrodes No. 1 and No. 3 in Figure 1) connected to an electrometer, as specified for flat specimens in IEC 62631-3-2:2015, IEC 61340-2-3:2000, or ASTM D257-14. The instrument shall be able to measure down to 1 nA resolution or lower. One electrode (electrode No. 1 in Figure 1) shall be circular with a diameter of d_1 = (50 ± 1) mm and the other will be larger, and shall completely cover the first (electrode No. 3 in Figure 1). Additionally, a guard electrode (Electrode No. 2 in Figure 1) shall be connected to ground during testing. The guard electrode helps to minimize noise from stray electrical currents. The gap (g in Figure 1) between electrodes 1 and 2 shall be between 1 mm and 10 mm. The polymer sample area shall be larger than the smaller electrode and large enough to span the gap to the guard electrode ($d_4 > d_1$ by 2 mm to 6 mm). Electrically conductive rubber can be used with metal electrodes to help ensure a good electrical connection. Because conductive pastes can contaminate the samples affecting the resistivity measurement, they shall not be used in these measurements.