
Merilni postopki za materiale, uporabljene v fotonapetostnih moduli - 1-6. del:
Enkapsulanti - Preskusne metode za določanje stopnje strjevanja v etilen-vinilnih
acetatnih enkapsulantih - Dopnilo A1

Measurement procedures for materials used in photovoltaic modules - Part 1-6:
Encapsulants - Test methods for determining the degree of cure in Ethylene-Vinyl
Acetate

Messverfahren für Werkstoffe, die in Photovoltaik-Modulen verwendet werden - Teil 1-6:
Verkapselungsstoffe - Prüfverfahren zur Bestimmung des Aushärtungsgrads der
Ethylen-Vinyl-Acetat-Verkapselung

[SIST EN 62788-1-6:2017/A1:2020](https://standards.iteh.ai/catalog/standards/sist/15edc23-8c2f-4127-8ebc-435c1e9b9dd6/sist-en-62788-1-6-2017-a1-2020)

Procédures de mesure des matériaux utilisés dans les modules photovoltaïques - Partie
1-6: Encapsulants - Méthodes d'essai pour déterminer le degré de durcissement dans
l'éthylène-acétate de vinyle

Ta slovenski standard je istoveten z: EN 62788-1-6:2017/A1:2020

ICS:

27.160 Sončna energija Solar energy engineering

SIST EN 62788-1-6:2017/A1:2020 en

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EUROPEAN STANDARD

EN 62788-1-6:2017/A1

NORME EUROPÉENNE

EUROPÄISCHE NORM

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English Version

Measurement procedures for materials used in photovoltaic
modules - Part 1-6: Encapsulants - Test methods for determining
the degree of cure in Ethylene-Vinyl Acetate
(IEC 62788-1-6:2017/A1:2020)

Procédures de mesure des matériaux utilisés dans les
modules photovoltaïques - Partie 1-6: Encapsulants -
Méthodes d'essai pour déterminer le degré de
durcissement dans l'éthylène-acétate de vinyle
(IEC 62788-1-6:2017/A1:2020)

Werkstoffe, die in photovoltaischen Modulen verwendet
werden - Messverfahren - Teil 1-6: Verkapselungsstoffe -
Prüfverfahren zur Bestimmung des Aushärtungsgrads der
Ethylen-Vinyl-Acetat-Verkapselung
(IEC 62788-1-6:2017/A1:2020)

This amendment A1 modifies the European Standard EN 62788-1-6:2017; it was approved by CENELEC on 2020-06-30. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this amendment 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 amendment 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.

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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

EN 62788-1-6:2017/A1:2020 (E)**European foreword**

The text of document 82/1691/FDIS, future IEC 62788-1-6/A1, prepared by IEC/TC 82 "Solar photovoltaic energy systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62788-1-6:2017/A1:2020.

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) 2021-03-30
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2023-06-30

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The text of the International Standard IEC 62788-1-6:2017/A1:2020 was approved by CENELEC as a European Standard without any modification.

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.cenelec.eu.

Add the following references:

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO 6721-1	-	Plastics - Determination of dynamic mechanical properties - Part 1: General principles	EN ISO 6721-1	-
ISO 14577-1	-	Metallic materials - Instrumented indentation test for hardness and materials parameters - Part 1: Test method	EN ISO 14577-1	-

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

AMENDMENT 1
AMENDEMENT 1

**Measurement procedures for materials used in photovoltaic modules –
Part 1-6: Encapsulants – Test methods for determining the degree of cure
in Ethylene-Vinyl Acetate**

**Procédures de mesure des matériaux utilisés dans les modules
photovoltaïques –
Partie 1-6: Encapsulants – Méthodes d'essai pour déterminer le degré
de durcissement dans l'éthylène-acétate de vinyl**

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FOREWORD

This amendment has been prepared by IEC technical committee 82:Solar photovoltaic energy systems.

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

FDIS	Report on voting
82/1691/FDIS	82/1720/RVD

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

The committee has decided that the contents of this amendment and the base 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.

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2 Normative references

Add the following new references:

ISO 6721-1, *Plastics – Determination of dynamic mechanical properties – Part 1: General principles*

ISO 14577-1, *Metallic materials – Instrumented indentation test for hardness and materials parameters – Part 1: Test method*

3 Terms and definitions

Add the following new term:

3.6 degree of cure

G_i

<indentation method> parameter that correlates with the extent of cross-linking within the EVA using the indentation method

Note 1 to entry: Unit: dimensionless.

5.2.1 Sampling and storage

Replace the existing subclause 5.2.1.1 with the following:

5.2.1.1

Because the results for the secondary method may depend on the make of EVA, test results may only be directly compared for the same formulation of EVA. Therefore, test specimens should come from the same manufacturer(s) for the same fabrication lay-up configuration (backsheet/EVA combination). Changes in the encapsulant that affect the curing process, including but not limited to a change of the material supplier, would require validating the correlation between $G_{\%}$ and the degree of cure. For example, if the percentage vinyl acetate content in the EVA resin changes, a new correlation between $G_{\%}$ and the degree of cure (from a secondary method) should be obtained because the percentage vinyl acetate content is known to significantly affect the viscoelastic-dependent cure characteristics of the encapsulant.

7 Test report

Replace the existing item h) with the following:

- h) identification of test method used and test instrument and other equipment used, including the laminator and the temperature, pressure, and time settings used, when applicable. In the case of the indentation secondary method (per correlation or usual use of method), the test temperature, tip material, tip geometry, and tip size, maximum indentation load, maximum indentation depth, and frequency of modulation (if applicable) shall also be reported;

Replace the existing item i) with the following:

- i) reference to sampling procedure, where relevant, including the number of tests per specimen;

Replace the existing item k) with the following:

- k) measurements (associated and their uncertainty), examinations and derived results supported by tables, graphs, sketches and photographs as appropriate including degree of cure, specimen mass, measured enthalpy, graphs of the enthalpy/temperature data, graphs of the crystallization peaks, and gel content;

Add the following new clause:

8 Indentation secondary method

8.1 General

An alternative secondary method, using indentation to characterize the degree of cure of EVA, has emerged from the PV industry. The method is presently being used by module manufacturers and has been demonstrated in in-line application. A general description of the principle, related equipment, and use of the method is given herein.

G_i is obtained using an indentation instrument, where the result may follow from the analysis of the applied load, penetration depth, use of a modulated applied load (such as harmonic stiffness, storage modulus, loss modulus, or $\tan[\delta]$), and/or the specimen viscoelastic response (including the relaxation or recovery response). G_i may be obtained from a more complicated dimensionless fit, including a fit applied to the specimen's viscoelastic response (e.g., using a Maxwell model) or a combination of characteristics monitored during indentation. G_i may be obtained from a dimensionless fit of the response of the specimen (for example

$$G_i = \frac{C_t - C_n}{C_m - C_n}$$