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Measurement procedures for materials used in photovoltaic modules – Part 7-3: Accelerated stress tests – Methods of abrasion of PV module external Surfaces

INTERNATIONAL
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COMMISSION

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MEASUREMENT PROCEDURES FOR MATERIALS USED IN PHOTOVOLTAIC MODULES –

Part 7-3: Accelerated stress tests – Methods of abrasion of PV module external surfaces

FOREWORD

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In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

IEC 62788-7-3 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is an International Standard.

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.

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INTRODUCTION

There is a need for abrasion test methods in the PV industry, particularly for the front and back surfaces of PV modules. This document defines a set of test methods to be used for evaluating the abrasion of materials and coatings in photovoltaic modules or other solar devices. Linear and rotary machine abrasion methods are specified that can be used to address durability to abrasion with respect to the cleaning of solar devices. Linear abrasion is intended to emulate traditional manual methods of cleaning, where the cleaning equipment typically acts perpendicular to the surface, giving a scratching motion. Rotary abrasion is intended to emulate popular robotic methods of cleaning, where the cleaning element often may act along the surface in a swiping motion. Relative to DIN 53778-2 and ASTM D2486, application specific modifications for the machine abrasion tests include the longer bristle length, use of abrasive (test dust) of the size encountered in PV, the use of dry or wet abrasive as may be encountered during cleaning modules, and the number of test cycles relative to the maintenance of PV systems. A falling sand method is specified that can be used to address durability to abrasion with respect to damage from ordinary use in the application environment, i.e., typically meteorological events. Relative to DIN 52348, modifications include the quantity of test sand, which is intended for examination of PV surfaces and coatings. A forced sand impingement method is specified that can be used to address durability to abrasion from severe weather events and/or the most challenging locations of use. Relative to IEC 60068-2-68, modifications include the composition of test sand that may be compared to the PV application and the falling sand test in this document as well as the specified carrier velocities based on the PV application. The methods in this document can be used to aid performance analysis and/or for the purpose of material design/selection. Comparing the linear brush, rotary brush, falling sand, and forced impingement methods, different rates of abrasion and/or damage morphology can occur between the different test methods – they are not expected to produce the same result.

Formal working reference materials are identified in this document. The purpose of the working reference is to verify the apparatus is installed and working correctly. The characteristic(s) of interest can be verified on a regular basis (monthly, weekly, etc.). The characteristic(s) of interest and their values (with acceptance limits for precision) will be given in a referencing document or future version of this document, based on the results of an interlaboratory precision study.

MEASUREMENT PROCEDURES FOR MATERIALS USED IN PHOTOVOLTAIC MODULES –

Part 7-3: Accelerated stress tests – Methods of abrasion of PV module external surfaces

1 Scope

This part of IEC 62788 defines the test methods that can be used for evaluating the abrasion of materials and coatings in photovoltaic modules or other solar devices. This document may be applied to components on the incident surface (including coatings, frontsheet, and glass) as well as the back surface (including backsheets or back glass). This document is intended to address abrasion of PV module surfaces and any coatings present using representative specimens (e.g. which can be centimetres in size); the methods and apparatus used here can also be used on PV module specimens (e.g. meters in size). A suite of tests and their methods are identified in this document, including falling sand, forced sand impingement, and machine (brush) abrasion. Materials and coatings can have different intended design purposes and design lifetimes and therefore no specific pass/fail criteria are defined in this document. The results of the testing can, however, be used to identify relative durability of coatings for various outdoor environments and cleaning practices. The methods can be used for the purpose of relative comparison, e.g. for the purpose of material or coating selection. The quantitative correlation between artificial abrasion and field erosion (which will depend on factors including climate or location of use as well as application, e.g., use of a tracker, rack-mount, roof-mount, building integrated, or vehicle integrated PV) can be established for each specific material or coating, which is beyond the scope of this document.

The correlation between the rates of degradation from the different test methods (linear brush, rotary brush, falling sand, and forced impingement) is beyond the scope of this document and may be covered in referencing documents. The correlation between the rates of degradation for unaged and aged specimens is also beyond the scope of this document and may be covered in referencing documents.

The methods related to the characterization of abraded specimens (which might include optical transmittance, optical reflectance, surface roughness, and surface energy) are not defined in this document; characterization methods from other standards (including optical transmittance, optical reflectance, electrical performance, surface roughness, and surface energy) can be applied to specimens abraded using the methods defined in this document. Methods for examining the contamination of specimens, including artificial soiling, are not examined in this document. Additional specimen conditioning can be applied prior to the methods in this document. The abrasion tests in this document can be referenced and/or applied in conjunction with an accelerated test or test sequence in other standards.

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 60068-2-68, *Environmental testing – Part 2-68: Tests – Test L: Dust and sand*

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Part 7-3: Accelerated stress tests – Methods of abrasion of PV module external surfaces

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