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Incorporating corrigendum July 2023

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Photovoltaic (PV) modules — Qualifying guidelines for increased hail resistance

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PHOTOVOLTAIC (PV) MODULES – QUALIFYING GUIDELINES FOR INCREASED HAIL RESISTANCE

FOREWORD

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IEC TS 63397 has been prepared by IEC technical committee 82: Solar photovoltaic energy systems. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
82/2062/DTS	82/2090/RVDTS

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 Technical Specification 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/publications.

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INTRODUCTION

The hail test (MQT 17) of IEC 61215-2:2021, 4.17 examines PV modules for minimum hail resistance by using spherical ice balls of a minimum diameter of 25 mm, or optionally larger. The requirements after the test, as specified in IEC 61215-2, are:

a) no intermittent open-circuit fault detected during the test,

b) no evidence of major visual defects,

c) wet leakage current meeting the same requirements as for the initial measurements and the power loss requirement of (Gate No. 2) IEC 61215-1:2021, 7.2.3.

The hail test (MQT 17) may cause visible damage detectable by MQT 01 as well as invisible internal damage not detectable by MQT 01. Such invisible damage may also only be detected by Gate No. 2 (power loss measurement after stress tests) if the damage is relatively large.

The IEC 61215 series [1][1] lays down requirements for the design qualification and type approval of terrestrial photovoltaic modules suitable for long-term operation in open-air climates. It is however not written with the intent to detect medium to long term performance losses caused by hail to internal parts not visible to the naked eye. Such internal damages may be micro-cracks of cells which over time can be propagated by other mechanical and thermo-mechanical environmental stresses not addressed by the test flow of IEC 61215-1:2021, Figure 2.

The hail test (MQT 17) of IEC 61215-2:2021, 4.17 is sufficient for the generic design qualification and type approval for applications and environments where PV modules are unlikely to be exposed to severe hail exposure; however, a standardized test for applications and environments where PV modules are likely to be exposed to higher hail stress is considered useful.

IEC 61215-1:2021, Clause A.4 says*:* "Not all modules will experience extreme weather or mishandling. Qualification testing that tests for performance retention under these circumstances may lead to costly overdesign. … It is recommended to first develop and gain experience with a TS related to hail resistance, module handling, and related performance losses. Such a document should consider that thermal cycles might be more effective than DML."

The share of generated photovoltaic energy globally is ever rising and the reliability and more detailed prediction of generated power including energy loss is becoming more important for the industry, in particular to the finance and insurance section of the industry.

The tests given in this document can differentiate the hail resistance of PV modules by exposing samples to hail stress prior to the selected tests of IEC 61215-2:2021, Figure 2 and measure the additional power loss to reference modules going through the same tests without hail stress. The test sequence MQT 20 cyclic (dynamic) mechanical load test, MQT 11 thermal cycling test and MQT 12 humidity freeze test post-hail stress tests used in this document are identical to the test sequence 2 mechanical stress of IEC TS 63209-1:2021 [2]. The hail test HMQT 17 used in this document contains changes to IEC 61215-2:2021, MQT 17 to improve accuracy, comparability and repeatability of results. Additional information can be found in the Hail Register [3]. This document, IEC TS 63397, aims to support in the selection of modules for specific regions with higher risk to hail and the improvement of module design.

In addition to the power loss caused by the additional hail exposure the reporting section includes electroluminescence images. The changes in these images alone are not always indicative of power loss but may, together with the power measurement data, provide additional insight.

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

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