

Standard

Qualification and Quality Requirements for Electrical Components on Space Solar Panels

AIAA standards are copyrighted by the American Institute of Aeronautics and Astronautics (AIAA), 1801 Alexander Bell Drive, Reston, VA 20191-4344 USA. All rights reserved.

AIAA grants you a license as follows: The right to download an electronic file of this AIAA standard for storage on one computer for purposes of viewing, and/or printing one copy of the AIAA standard for individual use. Neither the electronic file nor the hard copy print may be reproduced in any way. In addition, the electronic file may not be distributed elsewhere over computer networks or otherwise. The hard copy print may only be distributed to other employees for their internal use within your organization.

AIAA S-112A-2013
(Revision of AIAA S-112-2005)

Standard

Qualification and Quality Requirements for Electrical Components on Space Solar Panels

Sponsored by

American Institute of Aeronautics and Astronautics

Approved

August 2013

Abstract

This standard establishes the quality requirements and provides methods for establishing the qualification of electrical components integrated onto spacecraft solar panels.

Published by
American Institute of Aeronautics and Astronautics
1801 Alexander Bell Drive, Reston, VA 20191

Copyright © 2013 American Institute of Aeronautics and
Astronautics
All rights reserved

No part of this publication may be reproduced in any form, in an electronic retrieval system
or otherwise, without prior written permission of the publisher.

Printed in the United States of America

ISBN 978-1-62410-245-5

Table of Contents

Foreword.....	v
Introduction.....	vii
1 Scope.....	1
1.1 Qualification by Similarity.....	1
1.2 Characterization by Similarity.....	1
1.3 Reporting Requirements for Qualification and Characterization by Similarity.....	1
2 Tailoring.....	1
3 Applicable Documents.....	1
4 Vocabulary.....	2
5 Summary of Qualification and Characterization Tests.....	5
6 Test Requirements.....	7
6.1 Sample Selection.....	7
6.2 Visual Inspection.....	9
6.3 Test Temperature Definitions and Requirements for Temperature Measurement.....	9
6.4 Functional Tests.....	10
6.5 Inspection and Function Test Ensemble.....	12
7 Qualification Tests.....	13
7.1 Life-Cycle Coupon Test With Humidity Exposure.....	13
7.2 Panel-Level Volatile Condensable Materials (VCM) / Acoustic Test.....	17
7.3 ESD Test.....	19
8 Characterization Tests.....	20
8.1 UV Effects.....	20
8.2 Angle of Incidence.....	21
8.3 Emittance.....	22
8.4 Solar Absorbance.....	23
8.5 Bypass Diode.....	24
8.6 Atomic Oxygen (AO) Test.....	24
8.7 Component Characterization.....	25
9 Quantity Requirements.....	25
9.1 Performance.....	25
9.2 Panel Reliability.....	25
9.3 Certification of Conformance.....	26
9.4 Lot Identification and Traceability.....	26

9.5	Test Equipment Maintenance and Calibration System	26
9.6	Incoming, In-process, and Outgoing Inventory Control	26
9.7	Process Control	27
9.8	Environmental Controls.....	27
9.9	Conformance of Production Solar Panels to Qualified Product.....	27
9.10	Electrostatic Discharge Sensitivity Program	27
9.11	Reworked Solar Panels	27
9.12	Design Construction and Process Change Control Procedures	28
10	Critical Materials and Designs	28
10.1	Scope.....	28
10.2	Requirements	28
11	Reporting Requirements	28
11.1	Reports to be Produced.....	28
11.2	Qualification Report	29
11.3	Characterization Report.....	29
11.4	Quality Report.....	30

List of Tables

Table 1	— Summary of data requirements for qualification and characterization tests.....	5
Table 2	— Summary of qualification and characterization tests	6

Foreword

AIAA Standard S-112-2005 “Qualification and Quality Requirements for Space Solar Panels” was originally developed to provide a “gold standard” for space solar panel qualification, with provisions included to supplement industry standards for quality. That document has been successfully used within the industry, and that experience led to the realization that a revision would be helpful.

Thus, this version of the standard contains improvements that were realized during that implementation. The result is a new standard that the Committee on Standards for Solar Cells and Solar Panels has developed and reached consensus that defines the best practices for space solar panel qualification.

The members of the AIAA Solar Cells and Solar Panels CoS who contributed to this revision are listed here:

Henry Brandhorst (Chair)	Carbon-Free Energy, LLC
Robert W. Francis (Co-Chair)	Aerospace Corporation
Edward Gaddy (Co-Chair)	Johns Hopkins University Applied Physics Laboratory
Amalia Aviles	The Boeing Company
Scott Billets	Lockheed Martin Space Systems Company
Robert Bornino	National Technical System
Michael Butler	Johns Hopkins University Applied Physics Laboratory
Ben Cho	Emcore Corporation
Steve Gasner	Lockheed Martin Space Systems Company
James Hall	Qioptiq Space Technology
Bao Hoang	Space Customs/Loral
Glenn Jones	Qioptiq Space Technology
Bongim Jun	Boeing-Spectrolab
John Lyons	Goddard Space Flight Center
John Martin	Qioptiq Space Technology
Scott Messenger	Naval Research Laboratory
Nikki Noushkam	Orbital Sciences Corporation
Tod Redick	Space Systems/Loral
Brad Reed	Consultant
Luis Rodriguez	U.S. Air Force
Dennis Russell	Boeing Radiation Effects Laboratory
Paul Sharps	Emcore Corporation
Brian Smith	Aerospace Corporation
Jared Smith	Space and Missile Systems Center
C. M. Chantal Toporow	Northrop Grumman Space Technology
Brian Wells	Auburn University

AIAA S-112A-2013
(Revision of AIAA S-112-2005)

The above consensus body approved this document for publication in April 2013. The AIAA Standards Executive Council (VP Standards, Laura McGill, Chairperson) accepted this document for publication in August 2013.

The AIAA Standards Procedures dictates that all approved standards, recommended practices, and guides are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any AIAA standards publication and no commitment to conform to or be guided by standards reports. In formulating, revising, and approving standards publications, the committees on standards will not consider patents that may apply to the subject matter. Prospective users of the publications are responsible for protecting themselves against liability for infringement of patents or copyright or both.

Introduction

This standard establishes the quality requirements and provides the methods for establishing the qualification of electrical components integrated onto spacecraft solar panels. Section 7 describes specific tests necessary to ensure the quality and reliability of solar panels intended for space application. Section 8 describes specific solar panel characterization tests necessary to characterize the performance of solar panels intended for space application. Section 9 describes the quality requirements for panels to be qualified to this standard. Section 11 describes the reporting format for the qualification tests in Section 7, the characterization tests in Section 8, and the quality requirements in Section 9.

Currently in preview, click buy full version

1 Scope

This document establishes qualification and quality requirements for the electrical components integrated onto spacecraft solar panels that carry single crystal silicon solar cells or gallium arsenide solar cells having any number of junctions including those with metamorphic and inverted metamorphic structure. In this standard the term panel defines the assembly of electrical components to be tested. The standard also defines requirements for solar panel manufacturers' quality systems and for qualification and characterization of the electrical components on solar panels.

This standard fully addresses the qualification of all panel components and the panel substrate only as they affect electrical performance. Requirements for acceptance testing are not defined in this document. In accordance with the conditions stated in this section, this standard accepts qualification and characterization by similarity when approved in writing by the customer.

1.1 Qualification by Similarity

If a panel to be qualified uses the same part types, materials, and processes as a panel previously qualified to this standard and is exposed to environments that are encompassed by the previous qualification to this standard, this standard's required tests and characterizations may be waived. If the same part types or materials are not available, equivalent part types or materials may be used if their pedigree to the same part type can be established and is satisfactory for the intended usage.

If some parts, materials, and processes have changed from similarity qualification, as defined by the paragraph above, the qualification may still suffice for the unchanged parts, materials, and processes. The similarity qualification will apply only to those parts and materials that are not changed and that do not make physical contact with a changed part or material; the qualifier must show by analysis that the remaining parts and materials are not affected to any degree by the presence of a changed part or material. The qualifier must execute the tests required by this standard on all the parts that are changed, or that are in physical contact with a changed part or that may be affected by a changed part.

1.2 Characterization by Similarity

Characterization is only required for parts and materials that were not characterized by similarity or that are changed or that were produced with processes that changed since the similarity characterization.

1.3 Reporting Requirements for Qualification and Characterization by Similarity

Report in accordance with Section 11.1f and 11.3e.

2 Tailoring

Tailoring of this document is allowed to meet specified requirements.

Wherever tailoring is proposed to a requirement herein, the rationale shall be stated and agreed upon. Written customer approval of the tailored sections is required.

3 Applicable Documents

The following applicable documents contain provisions which, through reference in this text, constitute provisions of this standard. For all documents, subsequent amendments to, or revisions of, any of these publications do not apply. In the event of a conflict between this standard, the documents cited below and other documents, this standard takes precedence.

AS9100

Quality Management Systems Requirements for Aviation, Space,
and Defense Organizations