IEC PAS 62257-10

Edition 1.0 2017-08

PUBLICLY AVAILABLE SPECIFICATION

PRE-STANDARD

colour inside

Recommendations for renewable energy and hybrid systems for rural electrification –
Part 10: Silicon solar module visual inspection guide

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RECOMMENDATIONS FOR RENEWABLE ENERGY AND HYBRID SYSTEMS FOR RURAL ELECTRIFICATION –

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FOREWORD

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The text of this PAS is based on the following document:	This PAS was approved for publication by the P-members of the committee concerned as indicated in the following document
Draft PAS	**Report on voting**
82/1274/DPAS	82/1312/RVDPAS

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IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This document is organized into a terminology section and a checklist, followed by a table cataloguing and describing the defects to be visually inspected. The schematics in the terminology section describe where each component is found on a common solar PV module. A severity rating is also defined to give users guidelines on how concerning a particular defect may be. In the checklist and the catalogue of defects, defects have been organized by the component of the module on which they appear, followed by severity rating. The order in which components are inspected goes from the back to the front of the module, following a procedure developed elsewhere [3][1]. The catalogue of defects is subdivided into two sections: the first referring to defects that might be found on new modules, and the second describing defects that might appear over time. This document is principally focused on defects that are observable at the beginning of product life. Selected significant defects that may appear over time are also included for completeness and to address the second-hand market.

This document was developed as a response to observations of sub-standard quality and counterfeit solar products present in developing world markets. Many consumers and retailers are not aware of the presence of significant visually observable defects that may limit performance and/or lead to premature product failure. Nor are they aware that good quality PV modules should last 25 years or more. Note that no amount of visual inspection or electrical product testing can guarantee that a module will perform reliably for 25 years.

Although visual inspection cannot catch all possible defects, it can be used as a screening method to identify poor performing products and potential early failure modes. This document was designed with the intention of being a quick tool that is inexpensive to implement, as it does not require any test equipment. Although helpful, no prior knowledge of solar photovoltaics is required to benefit from this guide, and an inspector should be able to be trained in its use in two days or less.

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

RECOMMENDATIONS FOR RENEWABLE ENERGY AND HYBRID SYSTEMS FOR RURAL ELECTRIFICATION –

Part 10: Silicon solar module visual inspection guide

1 Scope

This document is designed to be used as a guide to visually inspect front-contact poly-crystalline and mono-crystalline silicon solar photovoltaic (PV) modules for major defects (less common types of PV modules such as back-contact silicon cells or thin film technologies are not covered herein). The modules under consideration may be of any size or rated power, however some specific use-cases for solar modules may have different requirements and therefore adaption of this document is application and institution dependent (ex. labelling may not be present for a solar module sold as part of a small off-grid lighting kit). This document is meant to supplement and support rather than replace international testing standards (for example IEC 61215 or UL 1703 [1], [2]). A lack of visually observable defects is necessary but not sufficient to determine if a module would pass IEC 61215 testing.

Several applications could be envisioned for this document, including use by:

- border agents to inspect product shipments at ports of entry to a country. Standardized rejection criteria could be used as grounds for barring defective products for import in conjunction with an adopted IEC standard such as IEC 61215;
- standards agencies or regulatory authorities in search and seizure efforts. A tool that can be used onsite to determine if defective or fraudulent products are found for sale in markets;
- retailers/distributors to ensure they are receiving acceptable quality products from manufacturers;
- installers/technicians when selecting product from retailers or distributors for customers;
- educators as a teaching tool for students of solar energy, for example when training technicians;
- inspectors of already installed solar products to catalogue defects and attempt to trouble-shoot failures.

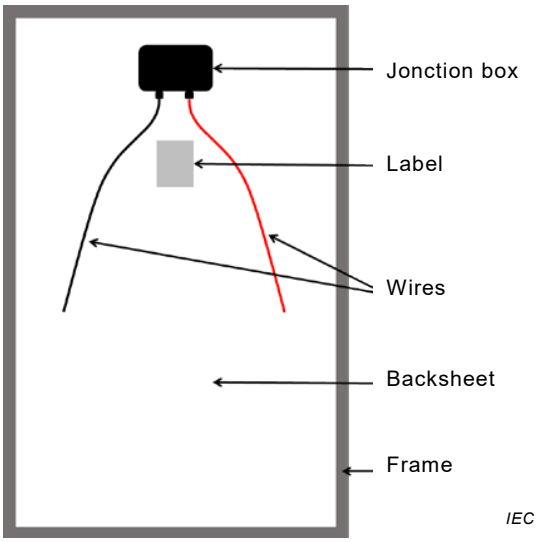
However, as this guide deals primarily with new modules, alternative tools are recommended for this task (see for example [3]).

2 Normative references

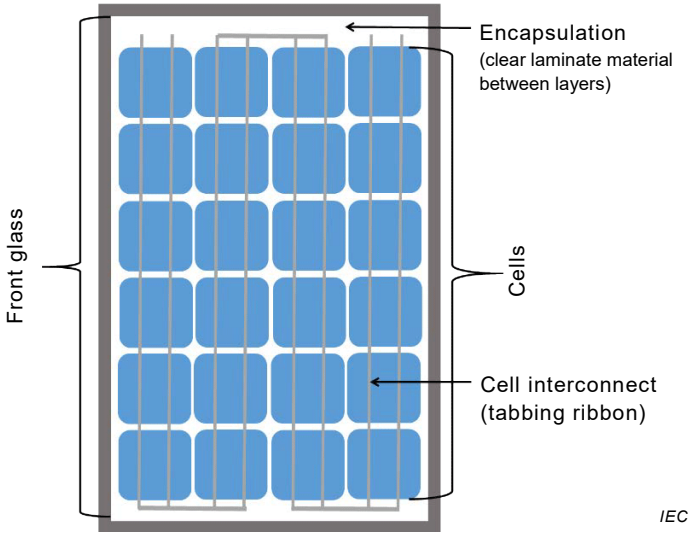
There are no normative references in this document.

3 Terms, definitions, symbols and abbreviated terms

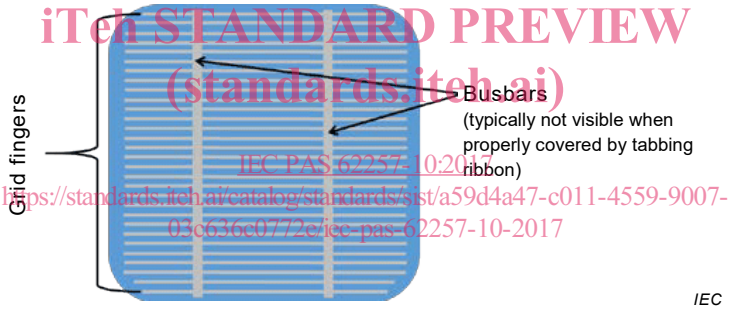
3.1 Clarification of terminology



Rear side of silicon module



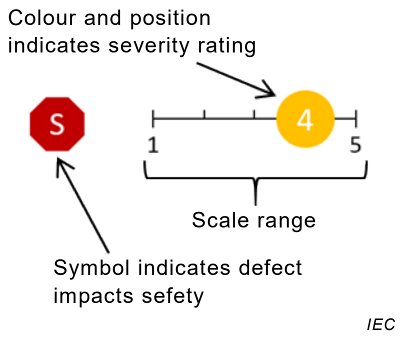
Front side of silicon module



Individual silicon solar cell

3.2 Clarification of severity rating

Efforts were made by the authors to provide a comparative rating of the severity of the defects. The range of the scale indicates influence to performance and/or reliability, and is given is from 1 (low severity) to 5 (high severity). A range is provided when the severity of a defect can vary, for example with the size of the affected area. An additional icon is given if the defect poses a potential safety risk to the installer or the end user. The authors assume no liability for actions taken as a result of this document.



Key

S Symbol indicating a safety risk, separate from quantitative scale

1 The defect is an indicator of poor quality with no direct effect on performance or reliability

2 The defect has a minor impact on performance and/or reliability

3 The defect has a moderate impact on performance and/or reliability

4 The defect has a high impact on performance and/or reliability

5 The defect is indicative of a major quality issue, a critical failure, or a counterfeit panel

4 Recommendations

4.1 General

The following subclauses provide recommended guidelines for the use of this document. This includes recommendations on an inspection procedure and accept/reject criteria.

Institutions may choose to adapt the checklist into a format unique to the needs of the given application. A cover page could be used to accomplish this. For example, different institutions/application might require specific administrative details to be recorded beyond the fields of module ID, inspector and date that are currently included (ex. location, reason for inspection, shipment, company, actions taken, comments, etc.).

4.2 Inspection procedure

The following procedure should be followed for each product lot to be inspected (ex. shipment, retail location, installation, etc.).

a) Identify and differentiate the different product types/sizes to be inspected within the lot.

b) Select a minimum of 8 samples of each size/type randomly for inspection (see IEC 61215 for sampling recommendations). Care should be taken to select samples from different locations (boxes, containers, etc.) within a lot (for example do not simply select the first 8 samples that are seen). Depending on the application this may not be sufficient: for example, if inspecting existing modules at a solar installation, it would likely be desirable to inspect 100 % of samples.

c) The inspector should complete one checklist per sample, proceeding through the list of defects in the order in which they are presented in order to ensure completeness.

   1) For each defect in sequence complete the checklist with an indication of defect presence, severity and whether or not the defect represents a potential safety risk.

   2) Depending on the requirements and the resources of the institution, it may be of interest to take photos of defects for inclusion in an inspection report, along with overview photos of the front, back, and label of a module.

   3) If further information or clarification is needed, refer to the detailed catalogue of defects which includes a description of the affected component, defect photos, a description of the defect, why it is important and guidelines on assessing defect severity.

   4) For used samples, both “new” and “used” checklists should be completed in this order.

Inspectors should be sufficiently familiar with defects unique to used modules such they can be identified during the inspection of ostensibly new products.

d) Once the inspection checklist is complete the inspector can review the results to determine whether the inspected module is acceptable for the intended application. The accept/reject criteria for a single module and an entire lot may be based on the recommendations below, or as per a standardized procedure determined by a given institution.

4.3 Accept / reject criteria

Acceptance and rejection criteria may be application and end user dependent. For example; small modules for off-grid applications may have slightly different quality requirements than full sized modules for utility scale applications. The market for small off-grid module may tolerate minor defects whereas the utility-scale market may not allow any visual defects which might pose even a small risk to the reliability and therefore the long term economic viability of the project.

Users of this document should make final accept/reject decisions based on a consistent, standardized and documented process which is justified by the needs of the market being served. The following provides a recommended set of guidelines for deciding on the acceptability of modules under visual inspection.

A solar PV module sample will be considered to be rejected due to its observable quality defects if any one of the following conditions are met:

a) If any single observed defect has been evaluated as a severity of 5. A severity of 5 indicates a major quality issue: a critical failure or a fraudulent module. This evaluation alone is sufficient justification for the rejection of a sample.

b) If any single observed defect has been evaluated to pose a safety risk. Under no conditions should a module that risks the safety of an installer or end user be considered acceptable.

c) If any combination of observed defects that have a summed severity score greater than or equal to 5 (acceptable summed value could be raised or lowered at the discretion of a given institution). This condition allows for the possibility to accept modules with minor defects that do not critically affect performance or reliability. This is done with the intent of not putting prohibitively stringent demands on developing markets that can tolerate minor deficiencies.

d) If any module that is expected to be new shows any of the used module defects. The defects listed under the used module checklist should be exclusively visible on used modules. At the discretion of the institution, the inspector might be directed to also always complete the used module checklist in order to rule out these defects, or alternatively simply complete the last row of the new module checklist to indicate the module does not appear to have been used previously.

If one or more samples are rejected for any of the above conditions then further action is required. Dependent on the application to which this process is applied and the goals of the inspection, several options are possible at the discretion of the responsible institution:

e) Reject the entire lot under inspection.

f) If only one of initial 8 samples is defective, reselect at minimum 8 random samples from the lot and repeat the above inspection procedure. If rejects are again found then reject the entire lot.

g) Require 100 % inspection on all samples within the lot and reject all non-conforming samples.

h) Instigate a more in-depth secondary inspection to further investigate the quality of the lot under question, likely to include electrical testing. The procedure for this testing is beyond the scope of this document.