



Standard Practice for Visual Inspections of Photovoltaic Modules¹

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1. Scope

1.1 This practice covers procedures and criteria for visual inspections of photovoltaic modules.

1.2 Visual inspections of photovoltaic modules are normally performed before and after modules have been subjected to environmental, electrical, or mechanical stress testing, such as thermal cycling, humidity-freeze cycling, damp heat exposure, ultraviolet exposure, mechanical loading, hail impact testing, outdoor exposure, or other stress testing that may be part of photovoltaic module testing sequence.

1.3 This practice does not establish pass or fail levels. The determination of acceptable or unacceptable results is beyond the scope of this practice.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards*:²

E772 Terminology of Solar Energy Conversion

3. Terminology

3.1 *Definitions*—Definitions of terms used in this practice may be found in Terminology **E772**.

4. Significance and Use

4.1 Environmental stress tests, such as those listed in **1.2**, are normally used to evaluate module designs prior to production or purchase. These test methods rely on performing electrical tests and visual inspections of modules before and after stress testing to determine the effects of the exposures.

¹ This practice is under the jurisdiction of ASTM Committee **E44** on Solar, Geothermal and Other Alternative Energy Sources and is the direct responsibility of Subcommittee **E44.09** on Photovoltaic Electric Power Conversion.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

4.2 Effects of environmental stress testing may vary from no effects to significant changes. Some physical changes in the module may be visible when there are no measurable electrical changes. Similarly, electrical changes in the module may occur with no visible changes.

4.3 It is the intent of this practice to provide a recognized procedure for performing visual inspections and to specify effects that should be reported.

4.4 Many of these effects are subjective. In order to determine if a module has passed a visual inspection, the user of this practice must specify what changes or conditions are acceptable. The user may have to judge whether changes noted during an inspection will limit the useful life of a module design.

5. Procedure

5.1 *Pre-Test Inspection*—Inspections performed prior to any environmental stress tests must document the module condition so that any changes that occur during testing can be identified during the post-test inspection.

5.1.1 Visually inspect each module to determine the presence or absence of anomalies or defects. Optical magnification is not required. Such anomalies or defects should include, but are not limited to:

- 5.1.1.1 Shipping damage,
- 5.1.1.2 Poor workmanship,
- 5.1.1.3 Defects in mounting brackets or structures,
- 5.1.1.4 Cracking, shrinkage, distortion, or tacky surfaces of polymeric materials,
- 5.1.1.5 Failure of adhesive bonding,
- 5.1.1.6 Bubbles or delamination of encapsulant materials,
- 5.1.1.7 Presence of foreign material,
- 5.1.1.8 Corrosion of fasteners, mechanical members, or electrical circuit elements,
- 5.1.1.9 Voids in or corrosion of any thin-film photovoltaic layers,
- 5.1.1.10 Discoloration of superstrate encapsulating materials,
- 5.1.1.11 Discoloration of active photovoltaic elements,
- 5.1.1.12 Broken, cracked, etched, scratched, wrinkled, or torn external surfaces,
- 5.1.1.13 Broken or cracked active photovoltaic elements,
- 5.1.1.14 Broken, cracked, or faulty electrical interconnections,

- 5.1.1.15 Cracked or damaged structural elements,
- 5.1.1.16 A photovoltaic cell touching another cell or the module frame,
- 5.1.1.17 Electrical terminals not bonded to the module or the module junction box,
- 5.1.1.18 Missing, peeling, or damaged metal layers on cell surfaces, and
- 5.1.1.19 Any additional anomalies or defects specified by the user of this practice that are evident.

5.1.2 Record the results of the visual inspection so that any changes that occur during subsequent testing can be identified. These records may be any combination of descriptions, diagrams, or images of any anomalies or defects noticed during the inspection. The location of any anomalies or defects must be unambiguously documented.

5.2 Post-Test Inspection:

- 5.2.1 Repeat 5.1.1, using identical lighting or examination conditions.
- 5.2.2 Repeat 5.1.2. It is not necessary to record anomalies or defects that were previously documented in the pre-test inspection

unless the anomalies or defects have visibly changed during the subsequent testing.

5.3 Comparison:

5.3.1 Compare the results of the pre- and post-test inspections to determine the visible effects of the environmental stress testing on the test samples.

6. Report

6.1 The report shall include the following items as a minimum:

- 6.1.1 Any anomalies or defects, in addition to the criteria of 5.1.1, that the inspections were required to document (see 5.1.1.19),
- 6.1.2 Results of both visual inspections as recorded in 5.1 and 5.2, and
- 6.1.3 Determination of the visible effects of the environmental stress testing from 5.3.

7. Keywords

7.1 energy; inspections; modules; photovoltaics; solar; testing; visual

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