

Connector Issues in Reliability*

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Abstract: We have extended our studies on wiring failures in the field reported at this workshop last year to more extensive examination of connector issues. New aspects of connector deficiencies are being reported in our PV field installations after relatively short outdoor exposure of 2-4 years. We examine factors which may be responsible for these failures and existing standards for their use. We find that there is a general lack of guidelines on connector design in wiring terminations both for module connections and at the Junction box inserts, or for handling during installations.

Examples of wiring failures after 2-4 years field exposure



1. Melted connector joint in wiring connecting two modules



2. Connector failures at junction box



3. Gap of 2-3 mm opens up between mating connectors without any obvious external damage, external stress or fracture in latches

Potential issues/causes in connector failures:

- Pin misalignments, metal-to-metal pressure contact mechanism failures
- Pin O-ring weathering
- Inadequate stress safety factors in latch design
- Dirt/dust ingress in latch and pin areas during shipping, warehousing and installation; some connector manufacturers recommend capping of pins, but module manufacturers do not pass on options
- Lack of uniform installation procedures to protect against stress on wiring and latches in the field
- Mixing of compatible connector parts from different manufacturers

Connector failure manifestations

- **Failures are caused by field conditions which combine extreme variable excursions:**
 - mechanical forces
 - temperature excursions
 - applied voltage
- **Types of failures may exploit poor design:**
 - overheating in pin joint likely caused by misalignments, poor contacts
 - broken latches
 - separation of two mating parts without obvious mechanical damage or heating
- **Connector design impact is not obvious in failures**

Major questions to be answered:

Are failures a result of:

- fundamental design flaws,
- inadequate certification testing, which may test for module but not electrical component durability
- systematic deficiencies in manufacturing/assembly practices, or
- lack of proper handling or installation methodology

Conclusion: There appears to be a critical gap in connector qualification, durability testing and installation procedure guidelines

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