

Important notes on product liability | Complying with standards and regulations

Cross-mating of PV connectors

Fact check of misleading and dangerous interpretation of test reports

Dear Customer,

Test institutes are repeatedly commissioned to test combinations of PV connectors from different manufacturers for compatibility. These are legitimate individual tests and may be performed. However, it is misleading and dangerous to conclude from these test results that PV connectors from different manufacturers can be safely combined and operated in a PV system. International studies¹ and a large number of claims show that cross-mating different connector brands hugely increases the technical, but also the legal risk of a PV system.

This «cross-mating» often leads to failures, loss of power, fires, and thus creates safety risks for people and the environment. In this case, the connector manufacturers are not liable since their products are not being used as described in their intended use. The testing institute is also not liable because the performed tests and their conclusions include a disclaimer. Usually, the installer is responsible for damage and malfunctions. Finally, such errors have a negative impact on the return on investment (ROI) and Levelized Cost of Electricity (LCOE) of the entire project.

Testing standards

The existing testing standards for PV connectors, such as IEC 62852:2014 + A1:2020 or UL6703, were written for connectors of the same type or type family from one manufacturer. A standard, therefore, refers to the tested connection of socket and plug within a type family and not to the respective individual parts of a connector. Thus, if a plug from manufacturer A is combined with a socket from manufacturer B, a new, non-certified connection is created. Therefore, the defined test sequences of a testing standard are not suitable to validate cross-mating.

Testing standards describe the minimum requirements for the safety of PV connectors, provided they have been developed and manufactured under the same quality management system, the same production processes and manufacturing tolerances, and sufficient knowledge of the materials and technologies used. Liability is also considered if there is damage. However, the industry's economic demands to make PV connectors as inexpensive and small as possible were also considered in developing these basic standards. Consequently, compliance with these standards allows market entry, but they do not serve as the only quality characteristic for a connector. These standards consider the influence of the high-cost pressure within the PV industry. Long-term tests are included

¹ TÜV Rheinland: [Statement](#), [SolarBankability.org](#), CEA: [Understanding PV Fire Risk](#), IEA PVPS: [Quantification of Technical Risks in PV Power Systems](#), [Fault tree analysis of fires on rooftops with photovoltaic systems](#) of University Putra Malaysia, the Technical University of Denmark, and the University of Edinburgh, PV Magazine: [Making the connection: Fires & electrical balance of systems](#)

in the above testing standards, but not those that consider possible effects of long-term operation of PV connectors from different manufacturers.

Today's standards are therefore not suitable for making a statement about the safety of combinations of PV connectors from different manufacturers. This also applies if two manufacturers designate their connectors as compatible on the condition that they inform each other of safety-relevant changes to the product. Even the smallest modifications can have a significant impact on the long-term function of the connection.

Damages and liability

Cross-connections can lead to burned connectors, arcing, and, in extreme cases, fires. There are various reasons for these common problems and damage when using combinations of different PV connectors. Among other things, a chemical incompatibility or also different thermal expansion parameters of the metal contact can lead to contact corrosion after some time. Under such circumstances, not only the project and the PV system are at risk, but also people and the environment. The question then arises as to who is responsible for such damage. The manufacturers of connectors are not liable if they exclude the combination with third-party products.

The PV system was implemented by the installer, which is why they are held responsible in most cases.

Type approval certificates versus test reports on individual tests

The internationally recognized design type certificate signals the tested and certified safety and quality of a series. It is issued by an accredited certification institute or a notified body. To obtain such a certificate, a positive evaluation of the manufacturer and its production by the testing body is a prerequisite. Not only is the production process, including handling of raw materials in incoming goods through to the dispatch of finished products, inspected, but also quality management in all its facets. This comprehensive testing is repeated at regular intervals to be able to hold the certificate. These recurring tests, which also include the points of the initial test, ensure a consistent quality of the products. These tests are performed on extensive sample quantities, usually taken from production by the expert.

A test report from individual testing is not a certificate. In contrast to a design certification, this describes exclusively the actual condition of the present sample. This report may be commissioned by any party without agreement. The one-time analysis is performed only on individual samples. The customer decides at the time of application what is to be tested and how. If applicable, this also specifies requirements, the fulfillment of which is to be demonstrated by testing for each product sample. Based on these reports, no statement can ever be made about the long-term safety of a product combination, much less a series.

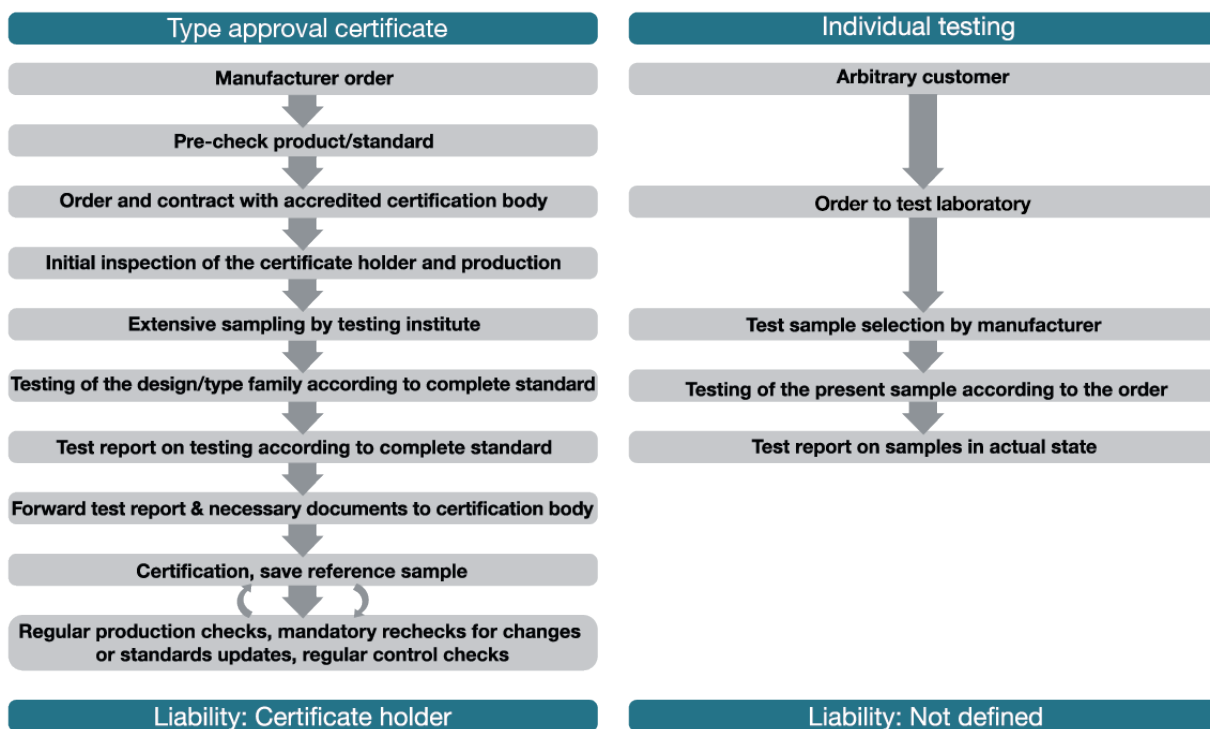


Table: Comparison of a design certificate and an individual test

A reputable testing institute will make a clear statement about this in the test result. Especially knowing that misleading, competition-distorting, and even dangerous statements are made based on such a report. As a positive example, TÜV Rheinland has included this clear note in test reports in the past. Knowing that, despite this clear indication, false claims were repeatedly made based on test reports, TÜV Rheinland consequently rejected tests of combinations of PV connectors from different manufacturers.

Summary

Reputable testing institutes should do everything possible to ensure that test reports on individual tests of cross-connections do not lead to false statements that are used deceptively or fraudulently. This can be done by making a clear statement in the final result of the test or by rejecting such tests. In the event of damage, product liability is not regulated, and responsibility usually lies with the installer. Both the manufacturer and the testing institute have noted a disclaimer.

Users of test reports on individual tests should be aware that the results do not allow any statement to be made about the safety of products or product families, but only reflect the condition of the present sample at the time of the respective individual test. The currently valid standards are not suitable for the consideration and qualification of combinations of connector parts of different manufacturers and types due to the scope of the test procedures, the test criteria, and the content. A test report on an individual test is not the same as a design certificate; it is misleading to derive compatibility from it. Furthermore, the currently valid product safety standards and installation standards of the IEC prohibit cross-connection.

Anyone who knowingly uses test reports for an individual test to make misleading and false statements not only accepts high risks themselves, but also induces others to tolerate dangerous conditions within a PV system. Cross-connections jeopardize all parties involved in a PV project through significant safety losses to the environment, life, and limb, as well as drastic project and financial risks.

Kind regards,

Stäubli Electrical Connectors AG
Allschwil, Switzerland – March 3, 2022



Matthias Mack
Vice-President Renewable Energy



Matthias Schuerch
Head of Global Product Management
Renewable Energy

Appendix | International Standards addressing described topic
International Installation Standards for PV Systems

Reference	IEC 62548:2016
Title	Photovoltaic (PV) arrays - Design requirements
Clause	7.3.9 Plugs, sockets and connectors “Plugs and socket connectors mated together in a PV system shall be of the same type from the same manufacturer, i.e. a plug from one manufacturer and a socket from another manufacturer or vice versa shall not be used to make a connection.”
Reference:	IEC 60364-7-712:2017
Title	Low voltage electrical installations - Part 7-712: Requirements for special installations or locations - Solar photovoltaic (PV) power supply systems
Clause	712.526 Electrical connections “Male and female connectors mated together shall be of the same type from the same manufacturer i.e. a male connector from one manufacturer and a female connector from another manufacturer or vice versa shall not be used to make a connection.”

International Product Safety Standards for PV Connectors

Reference	UL6703
Title	Connectors for Use in Photovoltaic Systems
Certification No	UL File E343181 (Original MC4, Original MC4-Evo 2)
URL	https://iq.ulprospector.com

Conditions of Acceptability:

“These devices have only been assessed for UL Recognition with specific types of mated connectors within their product family. They have not been assessed to operate with any other similar devices from any other manufacturer. “

Reference	IEC 62852:2014+A1:2020
Title	Connectors for DC-application in photovoltaic systems – Safety requirements and tests
Certification No	R 60127190 (Original MC4), R 60127169 (Original MC4-Evo 2)
URL	https://www.certipedia.com