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Statement of TUV Rheinland concerning interoperability of Photovoltaic (PV) connectors of different types and/or manufacturers

In many PV power plants PV modules are installed which are (mostly) from same type but fitted with PV connectors of different types, sometimes even produced by different manufacturers.
This circumstance brings with it that it is likely that such dissimilar connectors will be mated.

Why is it possible to mate connectors of different types?

In contrast to a few types of plugs and socket-outlets for use in household or industry systems, for which dimensions including their permissible tolerances are defined in product standards, such are not fixed for many other connectors, in particular not for PV connectors.

Some of the manufacturers for PV connectors have adapted the dimensions of connectors of a leading producer to their own connector types.
As a result it is possible to mate those connectors. Sometimes this is advertised by the producers as "compatibility".

Is it permitted to mate PV connectors of different types?

Several countries, e.g. France, already require the installation of connectors in PV arrays explicit from the same manufacturer in PV arrays. Australia changed their grid codes to ban the wording "compatible with" in reference to PV connectors. Currently standards for PV systems and PV arrays are under development, which also prohibit the engagement of connectors of different manufacturers.

How does TÜV Rheinland assess the mating of connectors of different types?

Under consideration of existing standards as well as under consideration of the field experience TUV Rheinland recommends to install and to mate connectors explicitly from same type and manufacturer. Aside from the insurability aspects ("who is responsible in case of an incident caused by dissimilar but mated connectors") several safety aspects are relevant for this recommendation.
Substantial problems can occur, e.g. if one of the manufacturers modifies the dimensions or tolerances of his connector. The water and vapor tightness may be affected by slight differences in the dimensions.
Problems may also occur due to incompatibilities of the materials of gaskets or sealings. The materials may be changed or destroyed completely.
This is also true for other materials, e.g. materials for insulation.

The current carrying metal parts also play a role. It is seldom the case that different manufacturers use the same materials or alloys.
This can, e.g. due to the different electrochemical potential, cause corrosion and subsequently high contact resistances. The consequence of the high contact resistances is loss of energy yield in the best case, in the worst case high temperatures which cause

deformation or melting of the materials such that the protection against electric shock is not provided anymore. Ultimately an ignition of the components might be the consequence.

Where is the assessment from TUV Rheinland coming from?

Unfortunately there are a high number of defects in PV arrays based on described effects which have been detected by TUV Rheinland or which have been announced to TUV Rheinland. The real number of defects is unknown.

Because of the detected defects TUV Rheinland already performed tests to determine the causes of such defects. For these tests connectors of different types were mated and subjected to long term tests. The results of these tests clearly confirmed the recommendation of TUV Rheinland: The mating of connectors from different types or manufacturers may significantly increase the risk of loss of performance and defects which cause hazards for human and environment.

Why do some manufacturers claim that TUV Rheinland confirmed a compatibility?

TÜV Rheinland performs both type approval tests as well as partial tests after consultation with applicants. So in the past some clients asked TÜV Rheinland to perform partial tests of combinations of connectors of different types according to specified sections of standards. Such requests for individual tests result in test reports covering the results of these . Such reports do not include a general confirmation of any property or compatibility nor are they equal to a certificate.

Will there be standardized connectors which allow the mating of connectors of different types in the future?

Theoretical there is nothing to be said against the development of a standard for connectors having the same diameters and tolerances, similar to the above mentioned standards for plugs and sockets for use in household or industry. The aim of such standardized household connectors is the flexible use of equipment. In contrast to household plugs for PV connectors it has to be considered that they will be exposed to all sorts of environmental conditions.
A standard for unified connectors would hence need to contain requirements which are so comprehensive that connectors fulfilling it would most likely have much higher production cost.
The last years nevertheless showed activity of several groups in the development of such a standard. Until not draft document is available.

How can a PV plant operator be sure not to get problems caused by the connectors?

The risk of loss of performance or damages can be reduced if a certified type of connector is installed in the plant.
A connector is only categorized as certified if it was tested with the appropriate counterpart.

So TUV Rheinland imperatively recommends clarifying the choice of PV connectors in the various parts of the system already in the planning phase of the PV plant.

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Among the above mentioned criteria it must also be checked whether possible environmental influences which are not covered by the existing certificate according to the currently valid safety standards have to be considered (e.g. installations in agricultural areas which might be exposed to the influence of ammonia laden atmospheres, or high temperatures due to operation in deserts or enclosures without air ventilation, etc.).

TÜV Rheinland offers support already in the planning phase of your projects.