Annex P5.1 PVT

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1. Abbreviations

The definitions in the Solar Keymark Scheme Rules apply

2. Introduction and definition

PVT collectors (named hybrid collectors in ISO 9806) generate heat and electric power at the same time. They are clearly identified in the scope of the test standard EN ISO 9806. The thermal performance and durability of a PVT collector is tested by the ISO 9806 standard and the electrical performance and safety is tested by the corresponding IEC (or EN) standards.

Even if the new EN 12975:2019 will cover PVT in its scope, there is still a need for further clarification and explanation.

3. Classification and Certification of PVT collector

Each PVT collector is considered a collector within the category it falls in as a thermal collector like air heating or liquid heating PVT collector.

Some Certification bodies may certify PVT collectors in compliance with EN 12975 (and test standard EN ISO 9806) and some certification bodies may certify PVT collectors in compliance with the Solar Keymark Scheme Rules. In both cases, the indication in this Annex shall be followed.

4. Family of PVT Collector

For PVT collectors, the electrical and thermal output power is not only depending on the size of the collector, but also on the varying cell efficiency and performance. Due to that fact, there is a need for an extended collector family definition for PVT.

Different sizes of PVT collectors and the used PV modules will be treated as every standard collector within the scheme rules. The largest collector has to undergo a full EN ISO 9806 and the smallest an additional thermal performance test. Every size has to be covered by IEC PV(T) certificates. If several certificates for the different sizes will be used, it has to be ensured via the constructional data files CDF, that the used components of the PV laminates are identical.

As the electrical performance may also vary within one size, there is a limit for the accepted electrical nominal power ranges within one PVT family. If the used power range of the based PV laminate (currently maximum ± 10%) is fully covered by one IEC certificate, no additional thermal performance characterisation is needed. The resulting influence on the thermal performance or the durability is negligible.

If the power range of the used PV modules is not covered by one certificate, the thermal performance has to be tested with the PVT with the highest and lowest nominal electrical output. For reliability testing, the PVT with the lowest nominal electrical output shall be used.

Note: The PVT with the highest nominal electrical output will correspond with the lowest thermal power and vice versa.

For PVT families including different back sheet colours, the lightest colour shall be used for thermal performance testing unless exemplary comparison tests are showing unique results.

5. Application of Specific Rules for PVT collectors

The Solar Keymark Scheme Rules shall be followed together with this Annex for certifying PVT collectors. Compliance with the product standard EN 12975in its latest version is required, taking into account the following considerations or additions:

Clause	EN 12975	Considerations or additions
1	Scope	Hybrid collectors are accepted in the scope. Electrical safety or other specific properties related to electric power generation are not covered
2	Normative References	EN ISO 9806:2017
3	Terms and definitions	Hybrid collectors are those that generate heat and electrical power
4	Symbols and abbreviations	EN ISO 9806:2017
5	Requirements	The stagnation temperature shall be determined using EN ISO 9806, taking into consideration clause 4 of this Annex Safety requirements regarding the electrical performance shall be dealt with in clause 6 of this Annex
6	Assessment and verification of constancy of performance - AVCP	The factory production control resp. the incoming goods inspection for the used PV module/ laminate shall consider the constancy of performance as well as the validity of the IEC certificates in an appropriate way.
7	Marking, labelling and packaging	The engineering drawings and list of components or materials must also cover the electrical components of the PVT collector. Therefore a CDF (Constructional data form) for the PV module used for testing shall be made available for the test laboratory and certification body.

The following requirements must also be met:

- The inspector must have the necessary skills regarding the electrical performance in order to assure that the Factory Production controls or changes in the product do not affect the compliance with the thermal performance and electrical safety.
- Any changes in the electrical components must be communicated to the Certification Body, just like any changes in the rest of the collector

6. Requirements for thermal performance

When performing the tests according to ISO EN 9806, the following requirements shall be fulfilled:

- The PV modules normally have a range of power output. As the influence on the thermal performance is only marginal, the panel to be tested can be selected out of the ranges given in clause 3 .
- PVT Air as well as liquid driven PVT collectors without additional glazing shall be tested as “WISC” (Wind speed dependency and net-irradiation has to be taken into account).
- The gross area of a PVT is usually defined by the gross area of the PV laminate. Outstanding connectors or cables are not considered. For overlapping products like PVT roof tiles, an appropriate area definition for gross area within an array has to be made and confirmed by the involved certification body.

7. Requirements for electrical safety and performance

7.1 General requirements

The Solar Keymark Certification of PVT collectors comply with the product standard EN 12975 (taking into consideration the actual circumstance) and the ISO 9806 test standard. The compliance of the IEC or corresponding EN standards is not the responsibility of the Keymark Certification Bodies; however, the electrical performance and security may affect the conformity of the product. Therefore, some additional requirements of this clause must be satisfied.

The PV module may have already been tested and certified, but as it is integrated in a PVT collector, some of its characteristics need to be rechecked.

The following requirements may be met independently:

a) The complete PVT collector is tested in compliance with the corresponding IEC standards by a test laboratory accredited according to ISO 17025 for the required IEC standards.

b) The PV module (before integration into the hybrid collector) is certified in compliance with the corresponding IEC standards, by an ISO 17065 accredited certification body with a scope covering the relevant IEC standards. The tests according to the corresponding IEC standards and technical specifications have been performed on the complete PVT collector by a laboratory accredited according to ISO 17025. In this case there might be some conditions accepted by IEC for partial testing, hence reducing double testing, if a verification procedure confirms that the assembly of the PVT did not adversely affect PV components and the PV module safety and durability through evaluation based on the technical specification IEC TS 62915.

Note: The definition of adequate tests to confirm the electrical safety of the assembled PVT can only be given by laboratory accredited to the relevant standards.

7.2 Requirements when testing according to IEC standards

The IEC or EN standards that may be complied with are listed enclosed. The latest revision of each standard is to be used:

IEC 61215 (all parts), *Terrestrial photovoltaic (PV) modules – Design qualification and type approval*

IEC 61215-1:2016, *Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 1: Test requirements*

IEC 61215-2:2016, *Terrestrial photovoltaic (PV) modules – Design qualification and type approval – Part 2: Test procedures*

IEC 62108:2016 *Concentrator photovoltaic (CPV) modules & assemblies – Design qualification and type approval*

IEC 62688:2017 *Concentrator photovoltaic (CPV) module and assembly safety qualification*

IEC 61730 (all parts), *Photovoltaic (PV) module safety qualification*

IEC 61730-1:2016, *Photovoltaic (PV) module safety qualification – Part 1: Requirements for construction*

IEC 61730-2:2016, Photovoltaic (PV) module safety qualification – Part 2: Requirements for testing

IEC TS 62915:2018, Photovoltaic (PV) modules – Type approval, design and safety qual-

ification – Retesting

7.3 Requirements on the Keymark Certificate or on the data sheet

The Solar Keymark certificate and/ or the Solar Keymark data sheet shall include the following information:

- certificate on the PV module or on the PVT collector
- If relevant, test report of the IEC tests performed on the PVT collector
- PV module information (manufacturer(brand), model, size and range of power)
- If the same module will be sold with different back sheet colours, the tested colour has to be given in the test report, the certificate and the data sheet

8. Substitution of PV Laminates

In case there is a need to substitute the used (and tested) PV laminate within an existing family, the following requirements applied:

Electrical issues:

As the electrical safety is not only related to the used components, but also to the production process (e.g. lamination process) and it's settings, it is not possible to substitute the PV laminate by a different certified type without any retests or verifications even when produced with the same materials and components. There is always the obligation for the required tests described in chapter 6.

The amount of retests to verify the conformity with the related standards is always under the responsibility of the test institute (certificate of conformity) or certification body or its representatives (full IEC certification).

Note: This topic is not covered by the technical specification about retesting, even if PVT issues will be considered in the future.

Solar Thermal issues:

If the electrical safety for the new PV module within the PVT is confirmed and there is no serious difference in construction (similar frame, used materials and back sheet as well as power range with respect to clause 3), there's no need for EN ISO 9806 retesting.

9. Final assembly of PVT's on mounting site

If the main components of a certified PVT (Heat exchanger & PV module) will be assembled only on site and not in the production site, it will be treated as most of the heat pipe or CSP concentrating collectors where the test sample(s) will also be assembled before testing in the test lab according to manufacturer's mounting instruction. It is not possible to send ready mounted PVT's for testing and only components to the mounting site.

The mounting instruction and method needs to ensure, that the PV module quality and safety will not be affected and a constancy of performance of the assembled PVT is ensured.

The qualification for on site assembly shall be stated in the test report, certificate and data sheet. For verification of field assembly quality, the CB might ask for additional on site evaluation.

10. Solar Keymark certification for retro-fit

According to Solar Keymark Scheme Rules and the scope of the standard EN 12975 and EN ISO 9806, there's no available standard to test and certify the heat exchanger for PVT's on their own, as the main component "absorber" with respect to light to heat transformation is missing. For this reason, these products are therefore excluded from Solar Keymark certification at least for the time being.

This exclusion from certification is independent from the general question of market access restriction due to legal requirements.

11. Avoidance of double testing/ unneeded tests

The following list of EN ISO 9806 tests might be substituted by IEC 61215/ 61730 tests, if they were already performed on the final PVT assembly:

	EN ISO 9806	IEC 61215/ IEC 61730
Mechanical load	Clause 15: As the damp heat test will be seen as more critical than a half time outdoor exposure, the mechanical load test according to IEC 61215 performed on the full PVT could be accepted, if the standard stagnation temperature of the PVT is less than 90°C	Mechanical load (MST 347 MQT 16) after 1000 h of damp heat climate chamber test at 85°C and 85% r.h.(MST 53/ MQT 13)
Impact resistance	Clause 16: As the number of impacts in IEC 61215 is much higher and mat least as critical as in EN ISO 9806, the IEC test could be accepted.	MQT 17
Standard stagnation temperature	Clause 9: The much more complex temperature test from IEC 61730 can substitute the calculation or test method from EN ISO 9806. The results shall be recalculated for 30°C ambient temperature	Temperature Test MST 21 (currently under IEC 61730-2, in the future according to IEC/TS 63126)
Outdoor Exposure	Clause 10: If the standard stagnation temperature (@30°C ambient) is less than 85 °C, the combination of Damp heat and thermal cycling test can substitute the 30 days of outdoor exposure test and it could be rated as equivalent to climate class A	Damp heat (MST 53/ MQT 13) Thermal cycling test (MQT 11)

12. Additional requirements for special PVT designs or operation mode

12.1 PVT's with standard stagnation temperatures above 85°C

For PVT's with temperatures above 85°C and without active stagnation prevention, the current IEC climate chamber tests are not sufficient for a full confirmation of conformity.

Note:

There is a new guideline for PV modules operating at higher temperature available soon:

IEC/ TS 63126 Ed.1.0"Guidelines for qualifying PV modules, components and materials for operation at higher temperatures" (Currently only as CD available)

This guideline is not yet covering such high temperatures, reached by additional glass front cover. For these kinds of systems, the most applicable standard would be the IEC standard for concentrating PV IEC 62108. It needs to be discussed with the PV experts and PV CB's, if this standard might be applicable. Furthermore, the use in general and the boundary conditions to be considered (battery capacity, one additional pump etc.) have to be discussed and agreed with CB' and experts of the IEC TC 82.