Annex P5.1 PVT

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solarkeymark.eu

Table of Contents

1. **Abbreviations** ... 3
2. **Introduction and definition** ... 3
3. **Classification of PVT collector and general rules** ... 3
4. **General procedure** ... 3
5. **Documentation, Physical inspection and factory inspection** ... 4
6. **Avoidance of double testing/ unneeded tests** ... 4
7. **Product Families and Tolerances** ... 4
   - 7.1 Gross area families ... 4
   - 7.2 Gross area tolerances ... 5
   - 7.3 Back sheet colour tolerance ... 5
   - 7.4 PV power families ... 5
   - 7.5 Change of cell type or cell interconnection ... 7
   - 7.6 Change of the front cover ... 7
   - 7.7 Change of back sheet or rear glass ... 7
   - 7.8 Change of absorber fixing method ... 7
   - 7.9 Change of location of the junction boxes ... 7
8. **Applicable PV standards** ... 8

1. Abbreviations

The definitions in the Solar Keymark Scheme Rules apply

2. Introduction and definition

PVT collectors generate heat and electricity simultaneously, with the electricity being generated by PV technologies. The thermal performance and durability of a PVT collector is tested by the ISO 9806 standard and the electrical performance and safety by the relevant IEC standards. This annex further specifies and clarifies the testing and certification procedures.

The gross area of a PVT is defined as in ISO 9488 Clause 3.7.7. In many cases it is equal to the gross area of the PV laminate. Outstanding connectors or cables are not included. For overlapping products like PVT roof tiles, an appropriate definition for the gross area within an array shall be made and confirmed by the relevant certification body.

3. Classification of PVT collector and general rules

PVT collectors are either liquid heating or air heating collectors and the appropriate ISO 9806 test procedures apply.

PVT collectors without additional front glazing are WISCs.

On-site assembled PVTs: If the main components of a certified PVT (heat exchanger & PV module) are only assembled on site and not at the production site, the test sample shall also be assembled according to the manufacturer's assembly instructions prior to testing at the laboratory. It is not possible to send fully assembled PVT's for testing and only components to the installation site. The mounting instruction and method shall ensure that the quality and safety of the PV module is not affected, and that the performance of the assembled PVT is constant.

PVTs with certified PV modules: PVTs using an IEC certified PV module to which a thermal absorber is attached.

RetroFit PVTs: Heat exchangers used to retrofit variable PV systems and upgrade them to PVT systems are not eligible for Solar Keymark certification yet.

High temperature PVT's with stagnation temperatures above 85°C: For PVTs with stagnation temperatures above 85°C and without active stagnation prevention, the current IEC tests are not sufficient and Solar Keymark certification is only possible if they are equipped with overheating and stagnation prevention devices. In this case they can be tested according to ISO 9806:2025 clause 5.3.3.

4. General procedure

In addition to EN 12975, a PVT collector shall also meet the safety requirements for PV products defined in IEC 61730-1 and -2 and, depending on the technology, shall be tested for durability and performance according to the applicable IEC standard (IEC 61215 series for multi- and polycrystalline modules, IEC 62108 for concentrator photovoltaic (CPV) modules, IEC 61646 for thin-film PV modules, as listed in clause 0).

The conformity with the EN 12975 is confirmed by testing in a Solar Keymark recognised testing laboratory. The conformity with the PV standards is confirmed by an ISO 17025 accredited PV laboratory with a scope covering the relevant IEC standards for this product.

As a general rule, at least two test laboratories are involved and at least two test reports are issued, which are the basis for the Solar Keymark certificate. All test reports shall be listed on the Solar Keymark data sheet.

Most PVTs are based on a PV module that has already been tested and certified. In this case, an ISO 17025 accredited PV testing laboratory will define a verification test procedure to confirm that the assembly of the PVT still conforms to the applicable PV standards. This tailor-made verification procedure shall be based on IEC TS 62915 (PV re-testing guidelines), where applicable. For modifications and technologies not covered by IEC TS 62915, the PV testing laboratory shall define appropriate procedures to verify compliance with the applicable PV standards.

If the PV component of the PVT is not certified before being assembled to a PVT, the complete PVT collector shall be tested like any other solar thermal collector according to EN 12975 and according to the corresponding IEC standard by a testing laboratory accredited according to ISO 17025 for the required IEC standards.

5. Documentation, Physical inspection and factory inspection

The factory production control, including the incoming inspection for the PV module/laminate used, shall consider the constancy of performance as well as the validity of the IEC certificates in an appropriate manner.

Documentation: The technical drawings, the specifications and the bill of materials shall include the electrical components of the PVT collector.

6. Avoidance of double testing/ unneeded tests

To avoid duplicative testing, the ISO 9806 tests listed below may be replaced by IEC 61215/61730 if they are performed on the final PVT assembly (and not only on the PV).

	ISO 9806:2025	**IEC 61215 / IEC 61730**
Mechanical load	Clause 14: The mechanical load test made according to IEC 61215 on the full PVT is accepted, if this is preceded by the damp heat test.	Mechanical load (MST 34 / MQT 16) if made after the damp heat test DH1000 (MST 53/ MQT 13)
Impact resistance	Clause 15: The number of impacts in IEC 61215 is higher than in ISO 9806. The result of the IEC test is accepted for the tested diameter.	MQT 17
Outdoor Expo-sure	Clause 9: The combination of damp heat and thermal cycling test can substitute the exposure test and can be considered as equivalent to climate class A	Damp heat DH1000 (MST 53 / MQT 13) and Thermal cycling test (MQT 11)

7. Product Families and Tolerances

For PVT collectors, the output power depends not only on the size of the collector, but also on the variable cell efficiencies. This is considered in an extended collector family definition for PVT.

Changes in the PV modules used for PVT collectors can affect the test results required by ISO 9806. In general, it is not possible to replace the PV components of a certified PVT collector with different PV components without re-testing or a separate verification procedure, even if the PV parts are manufactured using the same materials and components.

The definition of re-tests to verify conformity with the relevant standards is always the responsibility of the PV test laboratory, the solar thermal test laboratory and the Solar Keymark certification body. In any case, the following guidelines shall be applied. Deviating decisions shall be justified by the TL/CB and communicated to the certificate holder. The TL/CB shall also inform the SKN about deviating decisions so that a harmonised treatment of specific cases by all TL/CBs can be ensured, e.g. by updating this Annex P5.1.

7.1 Gross area families

Different sizes of PVT collectors are basically treated as defined in EN 12975. The PVs used within a family shall either i) be covered by an IEC certificate or ii) the involved PV laboratory shall verify and confirm by consulting the construction data files CDF that the used components of the PV laminates are identical for all members of the family.

If the gross area within a family only varies by <2% and the heat exchanger remains unchanged, the thermal performance parameters can be recalculated according to Annex H of ISO 9086:2025 and a data sheet with the different sizes shall be issued.

If the gross area within a family varies only between 2 % and 15 % and the heat exchanger remains unchanged, at least the mechanical load of the largest module shall be tested, and the thermal performance of all members shall be recalculated according to Annex H of ISO 9806:2025. Depending on the design and specifications, additional testing may be required by the CB.

If the gross area varies by more than 15%, a full test of the largest member of the family and a thermal performance test of the smallest member is required, as for all Solar Keymark families.

7.2 Gross area tolerances

If the gross area of a certified product is changed by <2% and if the design of the heat exchanger is unchanged, the thermal performance parameters shall be recalculated according to Annex H of the ISO 9086:2025 and a new datasheet shall be issued with the new parameters. No further retesting is required.

If the gross area is changed between 2 and 15% and the design of the heat exchanger is unchanged, at least the mechanical load test shall be performed, and the thermal performance shall be recalculated according to Annex H of ISO 9806:2025. Depending on the design and specifications, additional tests may be required by the CB.

If the gross area is changing by more than 15% a complete retest is required.

7.3 Back sheet colour tolerance

PVTs with different back sheet colours can be considered as members of a family if the thermal performance was tested with the brightest colour and the durability with the darkest colour.

7.4 PV power families

7.4.1 General

Families of PVTs with different PV power ratings are possible. In general, it is expected that the modules used in such a family are all covered by a single IEC certificate. If the power range of the PV modules used is not covered by a single IEC certificate, the thermal performance shall be tested with the PVT with the highest and lowest rated electrical output. For reliability testing, the PVT with the lowest rated electrical power shall be used.

7.4.2 Determination of the PV power tolerance

The following procedure is used to calculate the maximum tolerance for the PV power ΔP_{tol}.

Calculate:

Total solar power falling onto the collector	$P_{in} = A_G G_{hem}$	(1)
Electric power under STC (from PV datasheet)	P_{el}	(2)
Peak power under SRC (from measurement)	$P_{th} = P_{Peak}$	(3)
Electric efficiency	$\eta_{El} = \frac{P_{el}}{A_G G_{hem}} = \frac{P_{el}}{P_{in}}$	(4)
Not converted solar power	$P_{nc} = P_{in} - P_{el} - P_{th}$	(5)

The incoming solar power which is not converted, is considered as maximum “available” energy for additional conversion to electric power, of course with the same electric efficiency as before. The maximum tolerance for the PV power is therefore defined as follows.

Maximum tolerance for the PV power	$\Delta P_{tol} = \eta_{El} P_{nc}$	(6)

To illustrate the procedure, two examples are detailed out in the following.

Example 1

Assume a PVT collector with a gross area of A_G = 2 m^2.

Total solar power onto the collector for SRC $P_{in} = 2000\ W$

Electric power under STC (from PV datasheet) $P_{el} = 500\ W$

Peak power under SRC (from measurement) $P_{th} = 1200\ W$

Electric efficiency $\eta_{El} = 500/2000 = 0.25$

Not converted solar power $P_{nc} = 2000 - 500 - 1200 = 300\text{W}$

Maximum tolerance for the PV power $\Delta P_{tol} = 0.25 \cdot 300 = 75\ W$

Meaning that for this PVT the maximum variation for the PV module is 500 W – 575 W

Example 2

If the same PVT is using a lower performing PV laminate, (example 400W instead of 500W):

PVT collector with A_G = 2 m^2

Total solar power onto the collector for SRC $P_{in} = 2000\ W$

Electric power under STC (from PV datasheet) $P_{el} = 400\ W$

Peak power under SRC (from measurement) $P_{th} = 1000\ W$

Electric efficiency $\eta_{El} = 400/2000 = 0.20$

Not converted solar power $P_{nc} = 2000 - 400\text{W} - 1000\text{W} = 600\text{W}$

Maximum tolerance for the PV power $\Delta P_{tol} = 0.20 \cdot 600 = 120W$

Meaning that for this PVT the maximum variation for the PV module is 400 W – 520 W.

The tolerance in example 2 is bigger, because the general efficiency is lower. If the impact of the PV performance on the total system efficiency is considered smaller, a bigger tolerance can be accepted.

It is evident that this reasoning is not physically correct, but it is suitable for certification purposes and the results remain within physically possible limits.

7.4.3 Application of the PV power tolerance

For this reason, the range of rated PV powers within a family is limited. The same limits apply whether a product is modified or whether a family of products is considered. The maximum tolerance for the PV power ΔP_{tol} as defined 7.4.2 must be understood as a maximum tolerance. It is not per se a permission to change the PV laminate within this range, additional requirements may apply.

For a single size PVT, the rated PV is allowed to span by $+/-\Delta P_{tol}$ from the rated PV power of the measured PVT (which is also defining the thermal parameters indicated on the datasheet).

For a family of different sizes of PVTs, the $+/-\Delta P_{tol}$ rule shall be applied to the PVT with the lowest thermal performance (hence the PVT which is delivering the performance parameters for the whole family). From this the P_{min} and P_{max} are calculated *per area* for all members of the family using the principles of Annex H of the ISO 9806:2025.

Example

The following family of size A1 and A2 is established:

A1: 1.5 m^2 PV: 150W-200W Tested: P_1 = 180W (-> parameters for datasheet)

Maximum tolerance for the PV power determined according to 7.4.2: $\Delta P_{tol} = 20W$

Meaning that

$$P_{A1,min} = P_1 - \Delta P_{tol} = 180W - 20W = 160W$$

$$P_{A1,max} = P_1 + \Delta P_{tol} = 180W + 20W = 200W$$

A2 is a bigger collector in the same family with Gross area 2.1 m^2, meaning that

$$P_{A2,min} = P_{A1,min} \cdot \frac{A_2}{A_1} = 160 \cdot \frac{2.1}{1.5} = 224W$$

$$P_{A2,max} = P_{A1,max} \cdot \frac{A_2}{A_1} = 200 \cdot \frac{2.1}{1.5} = 280W$$

meaning that for A2 the PV power may vary between 224 Wand 280 W.

To cope with the standard rating values of PV power, the minimum values can be rounded to the next lower 5W step and the maximum values to the next upper 5W step. So that the range 224W to 280 W can be understood as 220W to 280W.

The resulting influence on the thermal performance or the durability is considered negligible.

7.5 Change of cell type or cell interconnection

If the cell types and/or cell interconnection are changed, the thermal performance limits apply. However, there is a risk of cell cracking, so the impact resistance test shall be repeated.

7.6 Change of the front cover

Changes in the transmittance of the front glass are relevant. However, the effect on thermal performance is considered to be sufficiently addressed if the PV power remains within the above-defined limits. If the thickness and/or structure of the front glass is changed, the same rules apply as for any other collector (see Appendix P1).

7.7 Change of back sheet or rear glass

Changing the back sheet material is not considered critical for the thermal performance of the PVT. Changing the back glass (for glass/glass modules) is treated in the same way as changing the front glass.

7.8 Change of absorber fixing method

If the fixing method between heat exchanger and PV is changed, a complete retest is required.

7.9 Change of location of the junction boxes

If the size of the heat exchanger remains constant, the effect on the thermal performance is negligible. This equivalence must be confirmed by the Solar Keymark testing laboratory. The position of the junction boxes can affect the mechanical load and impact resistance. Depending on the assessment of the CB and the Solar Keymark testing laboratory, the mechanical load test and/or the impact resistance test may have to be repeated.

8. Applicable PV 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 61215-1:2021 RLV Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1: Test requirements

IEC 61215-1-1:2021 RLV Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-1: Special requirements for testing of crystalline silicon photovoltaic (PV) modules

IEC 61215-1-2:2021+AMD1:2022 CSV Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-2: Special requirements for testing of thin-film Cadmium Telluride (CdTe) based photovoltaic (PV) modules

IEC 61215-1-3:2021+AMD1:2022 CSV Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-3: Special requirements for testing of thin-film amorphous silicon based photovoltaic (PV) modules

IEC 61215-1-4:2021+AMD1:2022 CSV Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 1-4: Special requirements for testing of thin-film Cu(In,Ga)(S,Se)2 based photovoltaic (PV) modules

IEC 61215-2:2021 RLV Terrestrial photovoltaic (PV) modules - Design qualification and type approval - Part 2: Test procedures

IEC 62108:2022 RLV Concentrator photovoltaic (CPV) modules and assemblies - Design qualification and type approval

IEC 61730-1:2023 Photovoltaic (PV) module safety qualification - Part 1: Requirements for construction

IEC 61730-2:2023 RLV Photovoltaic (PV) module safety qualification - Part 2: Requirements for testing