

TEST REPORT

N° 131244-663693Ev

English version - Original in French

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OBJECT : Tests according to a particular protocol on PV fastener device (réf. : 'PowAR Snap S') associated with system (Standard Strut Rail') protective grounding of photovoltaic panel.

Carried out tests : September to November 2014

This document contains 10 pages

Fontenay-aux-Roses, on 2014/11/18

Technical manager,

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Original in French signed by Alain POSLUSZNY

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1. OBJECT

The purpose of the tests was to verify the electrical performances of a photovoltaic module fastener assuring the grounding of panels.

2. TESTED SAMPLES

The role of the device is to mechanically fasten the module while allowing earthing continuity between the aluminum framework (insulated surface) of a photovoltaic panel and the support (Standard Strut Rail).

Fastener used with Standard Strut Rail system : 'PowAR Snap S'

The fastener is manually inserted onto the panel. During this operation, the teeth of the tab (upper part of the fastener) scratch the insulation and penetrate into the metal frame. Then, the assembly is mounted onto the support by snaping.

Standard Strut Rail with fastener 'PowAR Snap S' :





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3. TEST PROGRAM

The testing program was as follows:

- Ground continuity test (10A, 25A et 40A), with sanctions of IEC 60439-1 (2004) § 8.2.4.1, (Results from the LCIE test report No. 130375-662487 Cr2014-10-01).
- Salt mist test, NF EN 60068-2-11 (1999),
- Sulfur dioxid test (SO2) with general condensation of moisture NF EN ISO 6988 (April 1995).
- Lightning current wave test, (Results from the LCIE test report No. 130375-662487 Cr2014-10-01).



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4. PROCEDURES

4.1 Ground continuity test

Methods :

The test intented to measure the electrical resistance of the fastener ("PowAR snap S") achieving the connection between the photovoltaic panel and a standard "Strut" rail profile.

The fastener has been assembled onto the module frame by the applicant (A RAYMOND).

The laboratory has snaped the assembly onto a standard "strut" rail.

Test was performed by injecting a current between the frame and the support. Current values selected were successively 10A, 25A and 40A.

Sample used for ground continuity test



'PowAR Snap S'

<u>Sanction</u>: Measured resistance are specified to be below $100m\Omega$.



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Results :

| Tested association | Current (A) | Resistance (mΩ) |
|----------------------------------------------------------|----------------|--------------------|
| 'PowAR Snap S' Standard Strut Rail + framework | 10 | 6.1 |
| | 25 | 6.2 |
| | 40 | 6.6 |

Result : PASS

4.2 <u>Salt mist test</u>

The sample consisted of a piece of frame equipped with a fastener ("PowAR snap S") and 'Standard Strut Rail' system.

The fastener has been assembled onto the module frame by the applicant (A RAYMOND).

The laboratory has snaped the assembly onto a standard "strut" rail.

After performing the measurement of contact resistance, the sample was submited to a salt mist test for a period of **240 hours**.

Following this conditioning, the sample was rinsed with water, then dried.

A new resistance measurement was then performed.

Test conditions :

Duration : 240h Temperature : $35 \pm 2 \ ^{\circ}C$ Orientation : horizontale pH : 6.5 to 7.2

Results :

| | Current | Resistance (mΩ) | |
|-----------------------------------------------------------|----------------|----------------------------------|---------------------------------|
| Tested association | Current (A) | Before Salt mist test 240h | After Salt mist test 240h |
| <pre>'PowAR Snap S' Standard Strut Rail + framework</pre> | 10 | 16.5 | 33.6 |



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Sample during the salt mist test



Sample after the salt mist test



<u>Result :</u> PASS

4.3 Sulfur dioxid test (SO2) with general condensation of moisture

The sample consisted of a piece of frame equipped with a fastener ("PowAR snap S") and 'Standard Strut Rail' system.

The fastener has been assembled onto the module frame by the applicant (A RAYMOND).

The laboratory has snaped the assembly onto a standard "strut" rail.

After performing the measurement of contact resistance, the sample was submited to a Sulfur dioxid test with general condensation of moisture

Following this conditioning, a new resistance measurement was then performed.

Test conditions :

- Temperature of oven
- S2 concentration
- Humidity
- Duration of the test
- Duration of the cycle
- Description of teh cycle
- : 168 hours : 24 hours

40± 2 °C

0.067 %

: 100 %

- Exposure to SO2 with moist air for 8 hours at ambient
 - conditions during 16 hours (23°C and humidity 75% max.)

Results :

| Tested association | Current | Resistance (mΩ) | |
|---------------------------------------------------|---------|--------------------|-----------|
| | (A) | Before S02 | After SO2 |
| 'PowAR Snap S' Standard Strut Rail + framework | 10 | 24.9 | 27.4 |

Sample during SO2 test



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Sample after SO2 test



Result : PASS

4.4 Impulse current wave test

Tests were performed on one new sample identical to the one used in 4.2.

The contact resistance measurements were performed before and after testing of current waves of impulse. The current was '8/20µs' form.

An impulse wave current was applied to the set.

On the first sample, the amplitude was set to 20kA peak.

<u>Results</u> : Obtained form 20kA : 6.8/21.5µs

| Current amplitude | Tested association | Courant (A) | Résistance (mΩ) | |
|-------------------|---------------------------------------------------|----------------|--------------------|-------|
| (kA) | | | Before | After |
| 19.5 | 'PowAR Snap S' Standard Strut Rail + framework | 10 | 1.56 | 5.7 |



Current wave : example 20kA peak (4kA / division)



Result : PASS

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Annex n° 1

MAXIMUM UNCERTAINTIES CHART

This chart shows the maximum uncertainty values according to tests that may be related in this document

| omparative tracking index measurementower measurementurrent measurementammer test – Impact energyoltage measurementesistance measurementeakage current measurementeakage current measurementme or time intervalRange from 1s to 9 minRange > 9 minumidity measurement (hygroscopic treatment, conditioning)50 % RH to 90 % RH> 90 % RHorce measurement (dynamometer) for mechanical strength test, pull test, testobe entryass measurement (weight)0 g to 5 kg (0 N to 49.05 N)5 kg to 9 kg (49.05 N to 88.29 N) ± 14 arth resistance measurement | ment uncertainty |
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| imensional measurement performed with a rule | ± 0.13 mm |
| | |
| imensional and angle measurements performed with profile projector ± 7 | ± 0.7 mm |
| | • |
| eedle flame test – Flame height | ± 1.8 mm |
| ghtning impulse-voltage test | |
| Impulse amplitude | ± 2 % |
| Rising and falling time | ±7% |
| Impulse tail duration = coverage factor | <u>± 5 %</u> APP_INDUS_E_V3 |