LAB N° 0951

TEST REPORT

Nr AR 11 TEST 026

11/1009

Cat. 0

Standard CEI EN 61701:2000 (identical to IEC 61701:1995)
Salt mist corrosion testing of photovoltaic (PV) modules

Issued to:

Ferrania Solis S.r.l.

Viale della Libertà 57, Ferrania
17014 Cairo Montenotte (SV) – Italy

Sample/s description:

Tested PV module type: AP 60-225

Extended PV module type:

Model name	Cell number	Cell size [mm]	Module size [mm]	Cell technology	Rated power [W]
AP 72-XXX	72	156 x 156	-	Polycristalline	From 255 to 290 with 5W steps
AP 60-XXX	60	156 x 156	1663 x 998	Polycristalline	From 210 to 240 with 5W steps
AP 54-XXX	54	156 x 156	-	Polycristalline	From 190 to 220 with 5W steps
AP 48-XXX	48	156 x 156	-	Polycristalline	From 170 to 195 with 5W steps
AP 36-XXX	36	156 x 156	-	Polycristalline	From 125 to 145 with 5W steps
AP 32-XXX	32	156 x 156	-	Polycristalline	124
AP 28-XXX	28	156 x 156	-	Polycristalline	108
AP24-XXX	24	156 x 156	-	Polycristalline	93
AP 21-XXX	21	156 x 156	-	Polycristalline	81
AP 15-XXX	15	156 x 156	-	Polycristalline	58
AP 12-XXX	12	156 x 156	-	Polycristalline	46
AP 9-XXX	9	156 x 156	-	Polycristalline	35
AP 6-XXX	6	156 x 156	-	Polycristalline	23
AP 4-XXX	4	156 x 156	-	Polycristalline	15

Annexes: 2

Test result: **Pass**

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Issue date:
May 18, 2011

Red sRL, Ver&appr:
Head of the laboratory
Dott. Ing Giuseppe Terzaghi

Summary of testing:	
Tests performed (name of test and test clause): **Salt mist corrosion test**	**Testing location:** **Laboratorio Albacert** **via Consorziale Saronnino, 70** **21040 Origgio (VA) - Italy**

Sampling:	Random sampling from production ☒ Prototype submitted by client ☐

GENERAL INFORMATIONS	
Possible test case verdicts: - test case does not apply to the test object .....:	N/A
- test object does meet the requirement.....:	Pass (P)
- test object does not meet the requirement.....:	Fail (F)
Testing:	
Date of receipt of test item [YYYY/MM/DD].....:	2011/01/14
Date (s) of performance of tests [YYYY/MM/DD] .....:	Start 2011/02/24 – End 2011/03/02
General remarks: The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory. "(see Enclosure #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report.	
Test item description:	

Trade Mark	***ferrania solis***
Manufacturer	**Ferrania Solis S.r.l.**
Module type	**AP 60-225**
Safety application class	**II**
Maximum system voltage [V]	**1000**
Maximum over-current protection rating [A]	**—**

Product Electrical Ratings:		**Copy of marking plate:**
AP 60-225		
Voc [V]	**37.41**	
Vmp [V]	**29.10**	
Imp [Adc]	**7.85**	
Isc [Adc]	**8.45**	
Pmp [W]	**225**	
Maximum system voltage [V]	**1000**	
Series Fuse Rating [A]	**—**	

Module assignment:		
Lab Serial Number	**Sample**	**Remark**
201165	FER60A110111AH0090	Model: AP 60 225
201166	FER60A110111AH0081	Model: AP 60 225

Module	
Front Cover.....:	Tempered solar glass – 4mm
Rear Cover .....:	White polymeric laminate
Encapsulation material .....:	EVA
Frame.....:	Aluminum frame, anodized Al 6060 Anticorodal
Dimensions (l x w x h) [mm].....:	1663 x 998 x 45
Module area [m²].....:	1.65
Cell	
Cell (include type) .....:	Poly-Si
Cells (l x w) [mm] .....:	156 x 156
Cell thickness [µm].....:	—
Cell area [cm²] .....:	243.36
Number of cells.....:	60
Components and other	
Cells per bypass diode .....:	20
Type of bypass diode.....:	—
No. of bypass diodes .....:	3
Junction box.....:	IP65 – Class II
Cable.....:	—
Connectors .....:	—
Adhesives (junction box).....:	—

IEC 61701 Ed.1 – Salt mist corrosion testing of photovoltaic (PV) modules			
Clause	Requirement + Test	Result - Remark	Verdict
	Initial examination	All modules	—
10.1	Visual inspection..... :	See table 10.1 Int	P
10.2	Maximum power determination ..... :	See table 10.2 Int	P
10.3	Insulation test ..... :	See table 10.3 Int	P
10.15	Wet leakage current test	See table 10.15 Int	P

Control Module	**Sample:** 201165		—
Test Module and procedure	**Sample:** 201166		—
	Salt mist corrosion test		—
	Final measurements: 10.1, 10.2, 10.3, 10.15	See table Ka-Salt	**P**

10.1 Initial	**TABLE: Visual inspection (Initial).**	—
Test Date [YYYY/MM/DD] .....:	2011/02/18	—
Sample #	Nature and position of initial findings – comments or attach photos	**Verdict**
201165	Nothing to report	P
201166	Nothing to report	P
Supplementary information: None		

10.2 Initial	**TABLE: Maximum power determination (initial)**			—
Test Date [YYYY/MM/DD] .....:	2011/02/23			—
Module temperature [℃] .....:	41.5			—
Irradiance [W/m^2] .....:	941			—
Sample #		**First Ratio [1] (A)**	**STD [2]**	**Result**
201166		1.004	0.0012	N/A
Supplementary information: [1] First Ratio between control module and measured [2] STD “standard deviation” this value must be ≤ 0.01%				

10.3 Initial	**Table: Insulation test (initial)**				—
Test Date [YYYY/MM/DD] .....:		2011/02/18			—
Test Voltage applied [V] .....:		3000 for dielectric breakdown 1000 for insulation resistance measurement			—
Sample #	**Measured**	**Required**	**Dielectric breakdown**		**Result**
	MΩ	MΩ	Yes (description)	No	
201166	2220	> 24		x	P
Supplementary information: Size of module [m²] = 1.65					

10.15 Initial	**TABLE: Wet leakage current test (Initial)**		—
Test Date [YYYY/MM/DD] ..... :		2011/02/18	—
Test Voltage applied [V] ..... :		1000	—
Solution resistivity [Ω cm] ..... :		< 3,500 at 22 ± 3℃	
Surface tension [Nm^{-2}] ..... :		N/A	
Solution temperature [℃] .... :		23	
Sample #	**Measured [MΩ]**	**Limit [MΩ]**	**Result**
201166	570	> 24	P
Supplementary information: Size of module [m²] = 1.65			

Ka-Salt	**TABLE: Salt mist corrosion test**	—
Test Date [YYYY/MM/DD] start/end.....:	2011/02/24 – 2011/03/02	—
Module temperature [℃] .... :	35	
NaCl concentration [% in weight] ..... :	5	
pH of the solution ..... :	6.5	
Total hours ..... :	98	—

Sample #	Open circuits (yes/no)	**Verdict**
201166	Yes	P

Supplementary information: none

(10.1 Visual inspection after salt mist corrosion test)	—
Test Date [YYYY/MM/DD] .....: 2011/03/03	—

Sample #	Nature and position of initial findings – comments or attach photos	**Verdict**
201166	Nothing to report	P

Supplementary information: none

(10.3 Insulation test after salt mist corrosion test)	
Test Date [YYYY/MM/DD] .....: 2011/03/09	—
Test Voltage applied [V] .....: 3000 for dielectric breakdown 1000 for insulation resistance measurement	—

Sample #	**Measured**	**Required**	**Dielectric breakdown**		**Result**
	MΩ	MΩ	Yes (description)	No	
201166	693	> 24		X	P

Supplementary information: none

(10.15 Wet leakage current test after salt mist corrosion test)	
Test Date [YYYY/MM/DD] .....: 2011/03/09	—
Test Voltage applied [V] .....: 1000	—
Solution resistivity [Ω cm] .....: < 3,500 at 22 ± 3℃	—
Surface tension [Nm^{-2}].....: N/A	—
Solution temperature [℃] ....: 23	—

Sample #	**Measured [MΩ]**	**Limit [MΩ]**	**Result**
201166	385	> 24	P

Supplementary information: none

(10.2 Maximum power determination after salt mist corrosion test)	—
Test Date [YYYY/MM/DD] .....: 2011/03/09	—
Module temperature [℃] ....: 41.2	—
Irradiance [W/m^2] .....: 981	—

Sample #	**Ratio before the test (A)**	**Ratio after test (C)**	**STD**	**Degradation [%] A – C**	**Result**
201166	1.004	0.983	0.0008	– 2.1	**P**

Supplementary information: Limit [%] = – 5

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---------- End of Test Report No. AR 11 TEST 026----------

List of Annexes

Annex 1: List of measurement equipment

Annex 2: Statement of the estimated uncertainty of the test results

Annex 1: List of measurement equipment

Description	Identification #	Application
Digital caliper	3.3	10.1
Millimetric scale LTF	3.8	10.1
Luxmeter, LP471PHOT, DeltaOhm	3.16	10.1
Examination table	6.28	10.1
Double support	6.5	10.2,
Pyranometer, CMP11, Kipp & Zonen	4.14 a1	10.2
Consolle	4.14	10.2
Insulator tester, Metriso 5000 D-PI	3.10 / 3.25	10.3, 10.15
Conductivity meter	5.1	10.15
Tank	6.9	10.15
Desk weighing scale	5.8	Salt mist corrosion test
NaCl	4.71 a2	Salt mist corrosion test
Salt mist chamber	4.71	Salt mist corrosion test

Annex 2: Statement of the estimated uncertainty of the test results

The measurement uncertainties stated in this document have been determined according to EA-4/02. They were estimated as expanded uncertainty obtained multiplying the standard uncertainty by the coverage factor k corresponding to a confidence level about 95%. Normally, this factor k is 2.

Salt Mist test: Temperature = 0.66%
Time = Negligible
Weight (NaCl) = 0.59%

10.2 Maximum power determination = 2.0%