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LAB N° 0951

TEST REPORT

Nr AR 14 TEST 019 rev. 1
13/0288

Cat. 0

Standard IEC 61701: 2011
Salt mist corrosion testing of photovoltaic (PV) modules

Issued to:

CAPPELLO GROUP SpA
ZONA IND.LE IV FASE VIALE 3 N°5
97100 RAGUSA(RG) – ITALY

Sample/s description:

Tested PV module type: CA300P72
Included Extended Types
- see Annex 3 -

Test result: **Pass**

Annexes: 3

The test results indicated in this paper are exclusively referred to the described sample/s and in the specified conditions of measure. Any other extension of the results to other sample/s or other conditions of measure are to be considered outside to the scope of this document.

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Issue date:
March 16th, 2016

Head of the Laboratory
Eng. Giuseppe Terzaghi



Test Report No.	: AR 13 TEST 019
Test performed by	: Fabio Zapparata
Written by	: Dr.ssa Manuela Grassi
Verified by	: Dr.ssa Marina Cancellier, Ph.D.
Approved by	: Eng. Giuseppe Terzaghi
Issued date [YYYY/MM/DD]	: 2014/04/11

Summary of testing:

<u>Tests performed (name of test):</u> Salt mist corrosion test	<u>Testing location:</u> Albarubens srl via Consorziale Saronnino, 70/20-22 21040 Origgio (VA) – Italy
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Summary of compliance with National Differences: N/A

Copy of marking plate:



Figure 1: Type label

Picture of sample:



Figure 2: Front/Rear view of test sample

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]	2014/01/13
Date (s) of performance of tests [YYYY/MM/DD]	Start 2014/01/16 – End 2014/02/19
General remarks:	
This report shall not be reproduced except in full without the written approval of the testing laboratory.	
The test results presented in this report relate only to the item(s) tested.	
Any additional text/description/comment, reported in "Supplementary information *", refers to opinions and interpretations, not accredited by ACCREDIA.	



"(see remark #)" refers to a remark appended to the report.
 "(see Annex #)" refers to an annex appended to the report.
 "(see appended table)" refers to a table in the Test Report.
 "(*)" refers to not accredited by ACCREDIA.

General product information:

Product Electrical Ratings:

Module type	CA300P72			
Voc [V]	45.14 V			
Vmp [V]	35.8 V			
Imp [Adc]	8.48 A			
Isc [Adc]	8.31 A			
Pmp [W]	300 Wp			
Maximum system voltage [V]	--			
Series Fuse Rating [A]	--			

Test item description:

Trade Mark..... :	MICRON
Name, monogram or symbol of manufacturer	CAPPELLO ALLUMINIO SRL
Type or model number	CA300P72
Serial number..... :	Serial number provided in a separate label embedded inside the module.
Polarity of terminals or leads	Positive leads marked with "+" sign and Negative leads marked with "-" sign on a label wrapped around the lead.
Maximum system voltage	1000V
Maximum over-current protection rating	12.85A
Fire safety class	Class B
Safety application class	A

Module assignment:

Lab Serial Number	Sample S/N	Remark
2014020	13110445	none
2014021	13110185	none
2014022	13110444	none

Description of module construction: (Manufactories and part numbers, unless otherwise specified)	
Sample	Random sampling from production <input checked="" type="checkbox"/> Prototype submitted by client <input type="checkbox"/> Sampling from field (already installed) <input type="checkbox"/>
<u>Identification of materials</u>	
Front cover type.....	Tempered Glass
Front manufacturer/model/thickness :	Interfloat 3.2mm
Rear cover type	PYE
Rear cover manufacturer/model/thickness	Coveme Dymat PYE Pet50u/Pet125u/Primer100u
Encapsulant type	E.V.A.
Encapsulant manufacturer/model.....	Etimex EVA Fast Cure Type 496.10
Frame type and material	ALLUMINIUM
Frame manufacturer	METRA
Adhesive for frame	SILICONE
Adhesive manufacturer/model	HENKEL , TEROSTAT 939
Adhesive for junction box	SILICONE
Adhesive manufacturer/model	DOW CORNING,744
Potting material.....	
Internal wiring dimension between cells	3mm
Internal wiring dimension between strings	3mm
Soldering material.....	RIBBON
Soldering material manufacturer/model.....	brucker spaleck 62%Sn,36%Pb,2%Ag.
<u>Cell</u>	
Cell type technology	Multicristalline silicon
Cell manufacturer/model	Solartech Energy Corp.; Multicristalline silicon solar cell
Cell manufacturing location	Taiwan
Cell dimensions L x W (mm)	156mmX156mm
Cell thickness (µm).....	210µ +/- 30 µ
Cell area (cm ²).....	24.336
<u>Components</u>	
Junction box manufacturer/model ...	Tyco electronics 1987458-6
Cable manufacturer/model	Tyco solar cable ZHSCG -35-X.X-Y
Connector manufacturer/model	Tyco electronics/7-1394461-2;7-1394462-2 .
Bypass diode manufacturer/model..	Schottky By pass Diode / SL1110

Module design	
Module dimensions L x W x H (mm) :	1975*998*45mm
Minimum distances Between cells ... :	2mm
Minimum distances Between cell and edge of laminate :	5mm
Minimum distances Between any current carrying part and edge of laminate :	5mm
Total number of cells :	72
Serial-parallel connection of cells..... :	72-1
Cells per bypass diode :	24
No. of bypass diodes :	3
Components information	
Diode	
Bypass diode rating [A] :	11
Bypass diode maximum junction temperature [°C] :	--
Bypass diode Thermal resistance from junction to leads (RTHJL) [°C/W] :	--
Bypass diode Thermal resistance from junction to case (RTHJC) [°C/W] :	--
Other :	none

IEC 61701 Ed.2 – Salt mist corrosion testing of photovoltaic (PV) modules

Clause	Requirement + Test	Result - Remark	Result
	Initial examination	All modules	—
5	Preconditioning	5 kWh/m ² Start: 2014/01/16 End: 2014/01/20	N/A
10.1	Visual inspection – MST01.....	See table MST01 Int	P
10.2	Maximum power determination	See table 10.2 Int	P
10.6	Dielectric withstand test – MST16.....	See table MST16 Int	P
10.15	Wet leakage current test	See table 10.15 Int	P
10.4	Ground continuity test – MST 13	See table MST13 Int	P
Salt mist	2 Module		—
	Salt mist corrosion test.....	Severity 1	—
	Final measurements MST01, 10.2, MST16, 10.15, MST13, 10.18 (only functionality test).....	See table Ka-Salt	P

MST01 Int	TABLE: Visual inspection (Initial).	—
Test Date [YYYY/MM/DD]	2014/01/20	—
Sample #	Nature and position of initial findings – comments or attach photos	Verdict
2014020	No major visual defects	P
2014021	No visual defects	P
2014022	No major visual defects	P
Supplementary information *: none		

10.2 Int	TABLE: Maximum power determination (initial)		—
Test Date [YYYY/MM/DD]	2014/01/20		—
Module temperature [°C]	Corrected to 25		—
Irradiance [W/m ²]	1		—
Sample #	First Ratio² (A)	Pmp (W) int	Result
2014021	0.996	--	N/A
2014022	0.996	--	N/A
Supplementary information *: ¹ Relative measurements with different irradiance levels (between 700 W/m ² and 1100 W/m ²) were performed. All 10.2 test performed in this test the report uses 2014020 as control module. ² First Ratio between control module and measured			

MST 16 Int	TABLE: MST 16 – Dielectric withstand test (Initial)			—
Test Date [MM/DD/YYYY]	2014/01/20			—
Test Voltage applied [V]	<input checked="" type="checkbox"/> 6000 for class A <input type="checkbox"/> 3000 for class B			—
Sample #	Measured	Required	Dielectric breakdown	Result
	MΩ	MΩ	Yes (description) No	
2014020	> 100	20		X P
2014021	> 100	20		X P
2014022	> 100	20		X P
Remarks: Minimum requirement according to the standard is 40 MΩ*m ² . Size of module [m ²] = 1.97				
Supplementary information *: Minimum Insulation Resistance Required [MΩ] = 20			2 nd Check: <input checked="" type="checkbox"/> sRL	

10.15 Int		TABLE: Wet leakage current test (Initial)		—
Test Date [YYYY/MM/DD]		2014/01/20		—
Test Voltage applied [V]		1000		—
Solution resistivity [Ω cm]		< 3,500 at (22 \pm 3) $^{\circ}$ C		
Solution temperature [$^{\circ}$ C]		23		
Sample #	Measured [$M\Omega$]	Limit [$M\Omega$]	Result	
2014020	> 100	20	P	
2014021	> 100	20	P	
2014022	> 100	20	P	
Remarks: Minimum requirement according to the standard is 40 $M\Omega \cdot m^2$.				
Size of module [m^2] = 1.97				
Supplementary information *: Minimum Insulation Resistance Required [$M\Omega$] = 20			2 nd Check: <input checked="" type="checkbox"/> sRL	

MST 13 Int		TABLE: MST 13 – Ground continuity test (Initial)			
Test Date [MM/DD/YYYY]		2014/01/20			—
Maximum over-current protection rating (A)		--			—
Current applied (A)		33.1			—
Test duration [min]		2			—
Location of designated grounding point		- Fixing point - An adjacent (connected) exposed conductive component with the greater physical displacement from the grounding points / Frame			—
Sample #	Position in test sequence:	Voltage (V)	Resistance (Ω)	Result	
2014020	Initial examination	0.5	R1=0.00054 / R2=0.00042	P	
2014021	Initial examination	0.5	R1=0.00034 / R2=0.00045	P	
2014022	Initial examination	0.5	R1=0.00034 / R2=0.00036	P	
Remark: The resistance between the selected exposed conductive component and each other conductive component of the module shall be less than 0.1 Ω .					
Supplementary information *: none					

Ka-Salt	TABLE: Salt mist corrosion test					—
Test Date [YYYY/MM/DD] start/end	2014/01/22 – 2014/02/19					—
Total cycles	4					—
Severity	1					—
Test procedure						—
1 test section	Module temperature [°C].....	:	35			—
	NaCl concentration [% in weight]..	:	5			—
	pH of the solution	:	6.5			—
	Total hours	:	2			—
2 test section	Days	:	7			—
	Temperature [°C]	:	40			—
	rel. Humidity	:	93%			—
Sample #	Open circuits (yes/no)					Result
2014021	Yes					P
2014022	Yes					P
Supplementary information *: none						
(MST01 Visual inspection after salt mist corrosion test)						—
Test Date [MM/DD/YYYY]	2014/02/19					—
Sample #	Nature and position of initial findings – comments or attach photos					Result
2014021	Nothing to report					P
2014022	Nothing to report					P
Supplementary information *: none						
(10.2 Maximum power determination after salt mist corrosion test)						—
Test Date [YYYY/MM/DD]	2014/02/19					—
Module temperature [°C].....	Corrected to 25					—
Irradiance [W/m ²].....	1					—
Sample #	Ratio before test (A)	Pmp (W) int	Ratio after test (C)	Pmp (W) final	A – C [%]	Result
2014021	0.996	--	0.991	--	-0.5	—
2014022	0.996	--	0.988	--	-0.8	—
Difference between First Ratio and Ratio after test (A-C) [%] ≤ 5%						P
Supplementary information *: ¹ Relative measurements with different irradiance levels (between 700 W/m ² and 1100 W/m ²) were performed. All 10.2 test performed in this test the report uses 2014020 as control module.						

(MST 16 – Dielectric withstand test after salt mist corrosion test)					
Test Date [MM/DD/YYYY]		2014/02/19		—	
Test Voltage applied [V]		<input checked="" type="checkbox"/> 6000 for class A <input type="checkbox"/> 3000 for class B		—	
Sample #	Measured	Required	Dielectric breakdown		Result
	MΩ	MΩ	Yes (description)	No	
2014021	> 100	20		X	P
2014022	> 100	20		X	P
Supplementary information *: The test was performed with a Test voltage of 5kV for application class A					
(10.15 Wet leakage current test after salt mist corrosion test)					
Test Date [MM/DD/YYYY]		2014/02/19		—	
Test Voltage applied [V].....		1000		—	
Solution resistivity [Ω cm].....		< 3,500 at (22 ± 3)°C		—	
Solution temperature [°C]		23		—	
Sample #	Measured [MΩ]		Limit [MΩ]	Result	
2014021	> 100		20	P	
2014022	> 100		20	P	
Supplementary information *: none					
(MST 13 – Ground continuity test after salt mist corrosion test).					
Test Date [MM/DD/YYYY]		2014/02/19		—	
Maximum over-current protection rating (A).....		--		—	
Current applied (A)		33.1		—	
Test duration [min].....		2		—	
Location of designated grounding point.....		- Fixing point - An adjacent (connected) exposed conductive component with the greater physical displacement from the grounding points / Frame		—	
Sample #	Position in test sequence:	Voltage (V)	Resistance (Ω)	Result	
2014021	Final examination	0.5	R1=0.0015 / R2=0.0018	P	
2014022	Final examination	0.5	R1=0.0030 / R2=0.0026	P	
Remark: The resistance between the selected exposed conductive component and each other conductive component of the module shall be less than 0.1Ω.					
Supplementary information *: none					

(10.18 Bypass diode thermal test after salt mist corrosion test).				
Test Date [YYYY/MM/DD]	2014/02/19			
Number of diodes in junction box	3			—
Diode manufacturer / type designation	Schottky By pass Diode / SL1110			—
Sample #	2014021			
	Diode 1	Diode 2	Diode 3	Result
Functionality Test passed? yes/no	Yes	Yes	Yes	P
Sample #	2014022			
	Diode 1	Diode 2	Diode 3	Result
Functionality Test passed? yes/no	Yes	Yes	Yes	P
Supplementary information *: none				

----- End of Test Report No. AR 14 TEST 019 -----

List of Annexes

- Annex 1: List of measurement equipment
- Annex 2: Statement of the estimated uncertainty of the test results
- Annex 3: Model to be included in the test report

Annex 1: List of measurement equipment

Description	Identification #	Application
Digital caliper	3.40	MST01
Tape Measure	4.16	MST01
Luxmeter, LP471PHOT, DeltaOhm	3.16	MST01
Camera	6.68	MST01
Examination table	6.28	MST01
Solar simulator AAA class	4.86	10.2
Pyranometer, SPLite, Kipp & Zonen	4.86 a1	10.2
Insulator tester, Metriso 5000 D-PI	4.137 I-II	10.15, MST 16
Ambient thermo hygrometer	5.10	MST16
Conductivity meter	5.1	10.15
Inox Tank	4.117	10.15
Portable timer	4.118	10.15
Milliohmmeter	4.2	MST 13
Double – Conversion UPS	6.65	MST 13
Desk weighing scale	5.8	Salt mist corrosion test
Salt mist chamber	4.71	Salt mist corrosion test
NaCl	4.71 a2	Salt mist corrosion test
Ageing chamber	4.116	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: Salt mist chamber: Temperature = 0.33%, Time = Negligible, Weight (NaCl) = 0.61%

Aging chamber: Temperature = 1.49%, Humidity = 4.14%, Time = Negligible

10.2 Maximum power determination: Ratio = 0.5%, Pmp = 2.0%

10.15 Wet leakage current test / MST 16 Dielectric withstand test: Voltage applied = 4.20%, Resistance = 14.1%, Time = 0.39%

MST 13 – Ground continuity test: Resistance = 3.1%



Annex 3: The photovoltaic modules with the models

Tested type	Cell number	Cell size [mm]	Module size [mm]	Cell technology	Rated power [W]
CA300P72	72	156X156	1979X998	POLY-S	300

*** Extended PV module type without need of re-testing (according to IEC61215 “Retesting Guideline”):**

Type *	Cell number	Cell size [mm]	Module size [mm]	Cell technology	Rated power [W]
CAXXP72	72	156X156	197*998	POLY-SI	From 310 to 250 with 5W steps
CAXXP60	60	156X156	1979*998	POLY-SI	From 260 to 200 with 5W steps
CAXXP54	54	243.36	1507x998	POLY-SI	From 230 to 165 with 5W steps
CAXXP48	48	243.36	1349x998	POLY-SI	From 210 to 150 with 5W steps
CAXXP42	42	243.36	1238x998	POLY-SI	From 190 to 130 with 5W steps
CAXXP36	36	243.36	1238x998	POLY-SI	From 125 to 90 with 5W steps
CAXXP24	24	243.36	1082x998	POLY-SI	From 110 to 70 with 5W steps
CAXXP18	18	243.36	926x998	POLY-SI	From 90 to 40 with 5W steps