KL SOLAR COMPANY PVT LTD

REPORT NUMBER: 13CA54226-S1

PROJECT NUMBER: 13CA54226

T1431, T1432, T2215,
T2216, T2233, T2234

Location (a)
UL India Lab,
UL India Pvt Limited,
Laboratory building,
Kalyani Platina
Campus, Sy.no.129/4,
EPIP Zone, Phase II,
Whitefield,
Bangalore – 560 066

Location (b)
UL India Pvt Limited,
413 Sector-8, IMT
Manesar, Gurgaon.

TEST DISCIPLINE: CHOOSE AN ITEM.

General details

Customer	KL Solar Company Pvt. Ltd.		
Manufacturer	KL Solar Company Pvt. Ltd.		
Program	NABL		
Test Lab Location	(a) UL Bangalore	**Refer to Cover page for the Location address**	
Item Under Test	Photovoltaic Module, Model KL240		
Type / Model	KL240		
Number of samples	1 sample		
Sample Identification	Photovoltaic module, model KL240		
Serial Number (If any)	Sample Card No. 1733078.		
Condition of IUT on receipt	Good		
Date of Receipt	8 October 2013		
Applicable Standard	**IEC 61701 SALT MIST CORROSION TESTING OF PHOTOVOLTAIC (PV) MODULES - Edition 1 - Issue Date 1995/03/01**		
Date of Testing (Start date)	14 October 2013	**End Date**	18 October 2013
Lab general* ambient condition	**Temperature in °C**		23±5°C
	Relative humidity in %		<70%
Date of Reporting	18 October 2013		
Test In-charge	Prathap R/ Pradeep N		

Fill in the rows with information or add hyphen (-)

Moumita Debnath Project Engineer **Reviewed by**	Shyam Saurabh **Authorised Signatory**

UL INDIA PVT. LTD. * BANGALORE *

Disclaimer

*The results of testing in this report apply only to the sample product/item, which was tested. UL Lab has not participated in the sample selection. This Test report shall not be reproduced except in full or partial without the written approval of the Lab. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties. *The applicable standard ambient condition supersedes the lab general ambient conditions.*

General Remarks (If any)

Testing of Solar Photovoltaic modules as per IEC 61701- Standard for SALT MIST CORROSION TESTING OF PHOTOVOLTAIC (PV) MODULES.

Name of Frame Manufacturer: Jiangyin Lutong Industrial

Grade of Aluminium: 6063-T5

Thickness of Aluminum Coating >16um

Coating/ plating Process: Anodization

Description of Item under Test (IUT)

1 sample of Crystalline photovoltaic module, model KL240 representing the modules KL008, KL010, KL012, KL015, KL018, KL020, KL024, KL025, KL030, KL037, KL040, KL045, KL050, KL055, KL060, KL065, KL070, KL075, KL080, KL085, KL090, KL100, KL110, KL120, KL130, KL140, KL150, KL170,KL180, KL190, KL200, KL210, KL220, KL230, KL240 was sent for testing.

Test results:

Test No.	Test Name	Results
1	Visual Inspection Test (Before Salt Mist Test)	No visual defects found
2	Maximum Power Determination (Before Salt Mist Test)	Before Salt Mist Test 237.19 W
3	Insulation Test (Before Salt Mist Test)	Before Salt Mist Test 1149 MΩ
4	Salt Mist Test (96 hours)	No Corrosion observed
5	Visual Inspection Test (After Salt Mist Test)	No visual defects found
6	Maximum Power Determination (After Salt Mist Test)	After Salt Mist Test 239.612 W
7	Insulation Test (After Salt Mist Test)	After Salt Mist Test 520 MΩ

Test methodology adopted

Visual inspection (Before Salt Mist Test)

Test samples
One sample of the solar module KL240 was submitted for testing.

Test conditions

Carefully inspect each sample under an illumination of not less than 1000 lux for the following conditions:
1. No mechanical deterioration of module components which would significantly impair their Function during their intended life.
2. No mechanical corrosion of module components which would significantly impair their Function during their intended life.

Compliance Criteria – The Visual inspection before Salt mist test shall not exhibit any mechanical deterioration or corrosion on solar modules which would significantly impair their function during their intended life.

Result –

The Visual inspection before Salt mist test did not exhibit any mechanical deterioration or corrosion on solar modules.

DATE: 2013-10-14

Maximum power determination (Before Salt Mist Test)

Test samples

Sample after Visual Inspection was subjected to Maximum Power determinations (Before Salt Mist Test).

Test configuration

The following equipment was used to perform I-V characteristic measurements in simulated sunlight (solar simulator)

a) Class A solar simulator in accordance with IEC 60904-9. The designated test area was greater than the area that is spanned by the test specimen.

b) A PV reference solar module in accordance with IEC 60904-2 was used to calibrate the sun simulator

c) The means for monitoring the temperature of the test specimen and the reference device to an accuracy of ±1 °C and repeatability of ±0.5 °C.

d) An irradiance sensor that tracks the instantaneous irradiance was placed in the test plane. This irradiance sensor was linear in the range of irradiances over which the measurements were taken.

e) The temperature of the reference device and the specimen was measured using instrumentation with accuracy of ±1 °C with repeatability of ±0.5 °C.

f) Equipment for measuring the current of the test specimen and reference device to an accuracy of ±0.2 % of the reading.

g) Equipment for measuring the voltage of the test specimen and reference device to an accuracy of ±0.2 % of the reading.

Compliance Criteria –

The Solar modules underwent the Maximum power determination test before Salt Mist Test, in order to record the Electrical data (Maximum Power) which was compared and analyzed for Percentage degradation after performing Salt Mist Test.

Result –

10.2	**TABLE: Maximum Power Determination (initial)**				2013-10-14
Cell temperature (°C) ..... :			25		25
Irradiance (W/m^2) ..... :			1000		1000
Initial examination					
Sample No.	Voc (V)	Vmp (V)	Isc (Amps)	Imp (Amps)	Pmp (W)
1	37.150	29.491	8.739	8.043	237.192

Lab Condition:-
Temp: 25°C
Humidity: 54.2%

DATE: 2013/10/14

Insulation Test (Before Salt Mist Test)

Sample Requirements

Same Solar module from Maximum power determination test was submitted for this test.

Test configuration

a) Connect the shorted output terminals of the module to the positive terminal of a d.c. insulation tester with a current limitation.

b) Connect the exposed metal parts of the module to the negative terminal of the tester

c) Increase the voltage applied by the tester at a rate not exceeding 500 V./sec. to a maximum equal to 1000 V plus twice the maximum system voltage (i.e. the maximum system voltage marked on the module by the manufacturer). If the maximum system voltage does not exceed 50 V, the applied voltage shall be 500 V. Maintain the voltage at this level for 1 min.

d) Reduce the applied voltage to zero and short-circuit the terminals of the test equipment to discharge the voltage build-up in the module.

e) Remove the short circuit.

f) Increase the voltage applied by the test equipment at a rate not to exceed 500 V/sec. to 500 V or the maximum system voltage for the module, whichever is greater. Maintain the voltage at this level for 2 min. Then determine the insulation resistance.

g) Reduce the applied voltage to zero and short-circuit the terminals of the test equipment to discharge the voltage build-up in the module.

h) Remove the short circuit and disconnect the test equipment from the module.

Compliance Criteria –

For modules with an area greater than 0.1 m^2, there shall not be any dielectric breakdown or arc-over during Insulation test, and the measured insulation resistance shall not be less than 24.69 Mega Ohms.

Results –

Sample #	Length m	Width m	Area (L x W) m^2	Minimum Resistance 40 Mohm*m^2/Area
1	1.637	0.992	1.62	24.69

The magnitude of the applied voltage and measured insulation resistance were as follows:

10.3	**Table: Insulation test**		
Module maximum system voltage rating (V, DC)..... :		1000	1000
Potential applied (V, DC) ..... :		3000/1000	3000
Initial Tests			
Sample #	Measured (MΩ)	Result	
1	1149	Pass	

For modules with an area greater than 0.1 m^2, there was no indication of dielectric breakdown or arc-over during Insulation test, and the measured insulation resistance was not less than 24.69 Mega Ohms.

Lab Condition:-
Temp: 24.7 Deg C
Humidity: 52.3%

Date:2013-10-14

Salt Mist Test (96 Hours)

Test samples

Same sample module was used for evaluating the Salt Mist test.

Test configuration

The chamber for this test was constructed of such materials that would not influence the corrosive effects of the salt mist. The detailed construction of the chamber, including the method of producing the mist are as follows:
a) The conditions in the chamber were within the limits specified;
b) A sufficiently large volume with constant, homogeneous conditions (not affected by turbulence) is Available
c) No direct spray impinges upon the specimens under test;
d) Drops of liquid accumulating on the ceiling, the walls or other parts did not drip on the specimens;
e) The chamber was properly vented to prevent pressure build-up and allow uniform distribution of salt fog. The discharge end of the vent was protected from squalls which can cause strong air currents in the chamber.

Atomizer (s)

The atomizer(s) used were of such a design and construction as to produce a finely divided, wet, dense mist. The atomizer(s) was made of material that is non-reactive to the salt solution.

Salt solution Concentration

The salt used for the test was high quality sodium chloride (NaCl) containing, when dry.
The salt solution concentration shall be 5 ± 1 by weight.

pH value

The pH value of the solution was 6.98, at a temperature of 35±2 degree C.

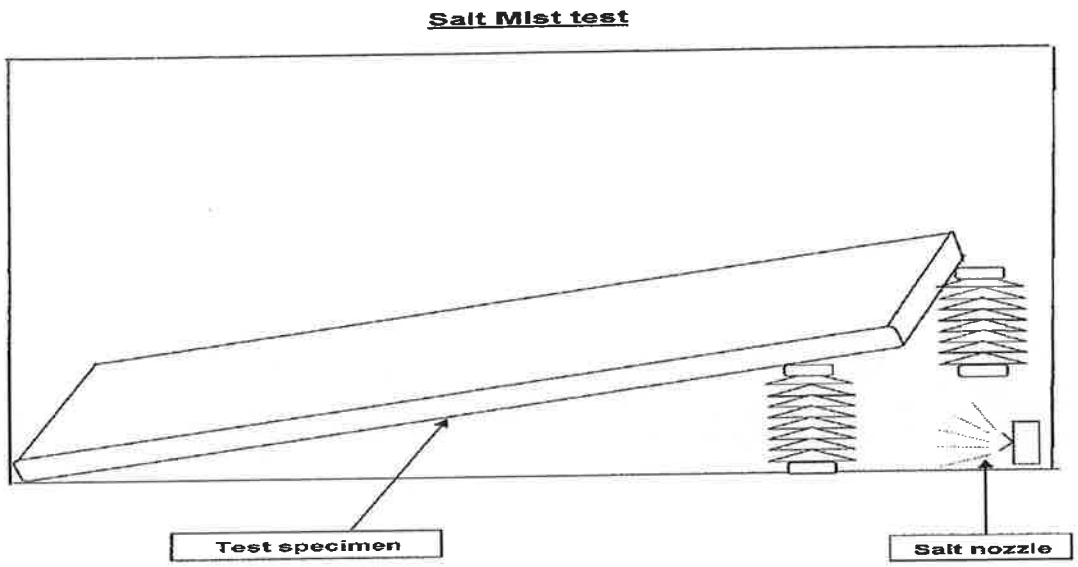


Fig.1– Schematic diagram of the test set-up / test lay-out

Compliance Criteria –

a) No mechanical deterioration or corrosion of module components which would significantly impair their function during their intended life.
b) The electrical performance (maximum power) shall not decrease by more than 5 % of the initial value.
c) The requirements of the insulation test shall meet.

Result –

No mechanical deterioration or corrosion of module components was observed.

Sample	Temperature	Humidity	Starting Time & Date	End Time & Date
1	35 Deg C	95 %	10:30 AM 2013-10-14	10:30 AM 2013-10-18

Date:

Visual inspection (After Salt Mist Test)

Test samples

The module which underwent the salt mist test were put under Visual Inspection test to determine any changes in the module which can significantly impair their function during their intended life.

Test conditions

Carefully inspect each sample for the following conditions:

- No mechanical deterioration of module components which would significantly impair their function During their intended life.
- No mechanical corrosion of module components which Would significantly impair their function during their intended life.

Compliance Criteria – The Visual inspection after Salt mist test Should not exhibit any mechanical deterioration or corrosion on solar modules which would significantly impair their function during their intended life.

Result –

The Visual inspection after Salt mist test did not exhibit any mechanical deterioration or corrosion on solar modules.

Date:

Maximum power determination (After Salt Mist Test)

Test samples

The solar module which undergone the visual inspection test were selected for maximum power determination

Test configuration

The following equipment was used to perform I-V characteristic measurements in simulated sunlight (solar simulator):

a) Class A solar simulator in accordance with IEC 60904-9. The designated test area was equal greater than the area that is spanned by the test specimen.

b) A PV reference solar module in accordance with IEC 60904-2 was used to calibrate the sun simulator

c) The means for monitoring the temperature of the test specimen and the reference device to an accuracy of ±1 °C and repeatability of ±0.5 °C.

d) An irradiance sensor that tracks the instantaneous irradiance in the test plane. This irradiance sensor was linear in the range of irradiances over which the measurements are taken.

e) The temperature of the reference device and the specimen was measured using instrumentation with an accuracy of ±1 °C with repeatability of ±0.5 °C.

f) Equipment for measuring the current of the test specimen and reference device to an accuracy of ±0.2 % of the reading.

g) Equipment for measuring the voltage of the test specimen and reference device to an accuracy of ±0.2 % of the reading.

Compliance Criteria –

The Solar module had undergone the Maximum power determination test after Salt Mist Test, in order to record the Electrical data (Rated Maximum Power) which will be compared and analyzed for Percentage degradation after performing Salt Mist Test.

Result –

10.2	**TABLE: Maximum Power Determination (After salt Mist)**				
Cell temperature (°C) ..... :			25		—
Irradiance (W/m^2) ..... :			1000		—
Initial examination					
Sample No.	Voc (V)	Vmp (V)	Isc (Amps)	Imp (Amps)	Pmp (W)
1	37.202	29.403	8.831	8.149	239.612

Sample No.	Pmax(initial)	Pmax (after salt mist)	Degradation (%)
1	237.192	239.612	-1.01

The electrical performance (maximum power) was not found to decrease by more than 5 % of the initial value.

Insulation Test (After Salt Mist Test)

Sample Requirements

Solar module KL240 was submitted for this test.

Test configuration

a) Connect the shorted output terminals of the module to the positive terminal of a D.C. insulation tester with a current limitation.

b) Connect the exposed metal parts of the module to the negative terminal of the tester

c) Increase the voltage applied by the tester at a rate not exceeding 500 V./sec. to a maximum equal to 1000 V plus twice the maximum system voltage (i.e. the maximum system voltage marked on the module by the manufacturer). If the maximum system voltage does not exceed 50 V, the applied voltage shall be 500 V. Maintain the voltage at this level for 1 min.

d) Reduce the applied voltage to zero and short-circuit the terminals of the test equipment to discharge the voltage build-up in the module.

e) Remove the short circuit.

f) Increase the voltage applied by the test equipment at a rate not to exceed 500 V/sec. to 500 V or the maximum system voltage for the module, whichever is greater. Maintain the voltage at this level for 2 min. Then determine the insulation resistance.

g) Reduce the applied voltage to zero and short-circuit the terminals of the test equipment to discharge the voltage build-up in the module.

h) Remove the short circuit and disconnect the test equipment from the module

Compliance Criteria –

For modules with an area greater than 0.1 m^2, there should not be any dielectric breakdown or arc-over during Insulation test, and the measured insulation resistance should not be less than 24.69 Mega Ohms

Results –

The magnitude of the applied voltage and measured insulation resistance were as follows:

10.3	Table: Insulation test		2013-10-18
Module maximum system voltage rating (V, DC).....		1000	—
Potential applied (V, DC)		3000	—
Initial Tests			
Sample #	Measured (MΩ)	Result	
1	520	Pass	

For modules with an area greater than 0.1 m^2, there was no indication of dielectric breakdown or arc-over during Insulation test, and the measured insulation resistance was not less than 24.69 Mega Ohms.

Lab Condition:-
Temp: 24.8 Deg C
Humidity:51.2 %

Equipment and Calibration details

Inst. ID No.	Instrument Type	Make	Function / Range	Last Cal. Date	Next Cal. Date
WPH01	Ph meter	METTLE-TOLEDO	up to 1000deg	Used standard solution for calibration	
SSC01	SALT SPRAY CHAMBER (PV LAB)	ASCOTT	up to 2000litres	03/01/2013	03/01/2014
IN03	Inclinometer	KAPRO	0 to 180 deg	01/02/2013	01/02/2014
SSS01	FLASH SOLAR SIMULATOR (PV LAB	SPIRE CORPORATION	1000W/m^2	Used reference module for calibration	
MON200	REFERENCE MODULE (MULTI)	SUN TECHNICS	200 W	NA	NA
DI03	DIELECTRIC TEST	KIKUSUI ELECTRONICS CORP.	up to 10kv ac/dc	01/12/2013	01/12/2014
RT02	INSULATION RESISTANCE TESTER (PV LAB)	KIKUSUI ELECTRONICS CORP.	1200Vdc / 5000 Mohm / 999 Sec	01/19/2013	01/19/2014

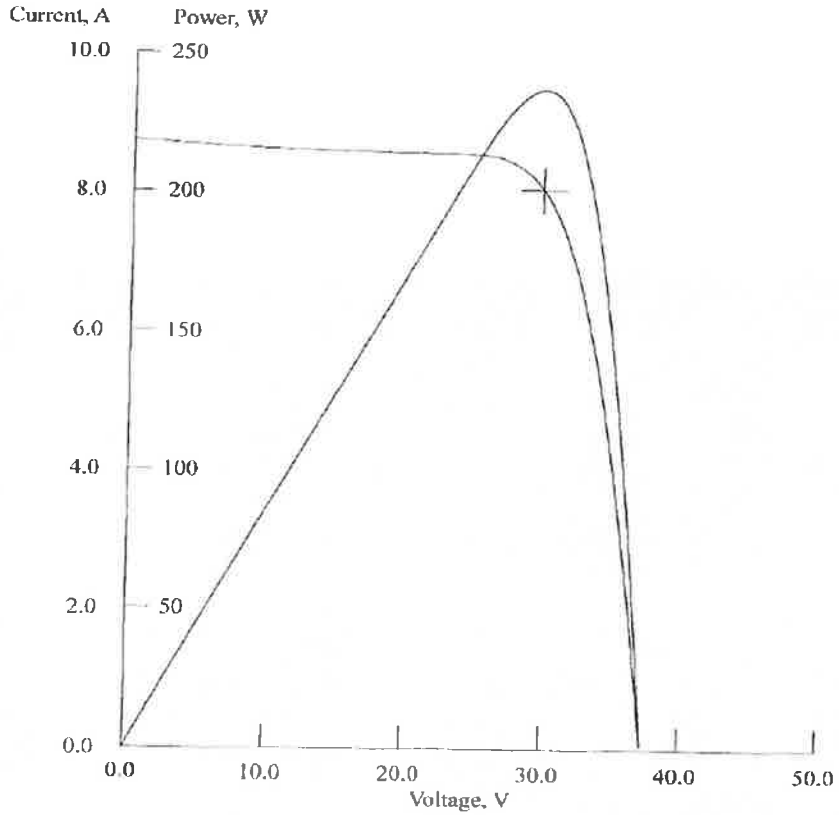
Test Results

Test Parameter	Standard & Clause Number	Sample ID	Date of testing	Result
Salt Mist Test	IEC 61701, Ed. 1	1733078 (Sample 1)	14 October 2013	P

P: Meets the requirements **F: Does not meet the requirement** **NA: Not applicable**

Appendix

Schematic Diagrams (Sample 1 PIV Graph before Salt Mist Test)

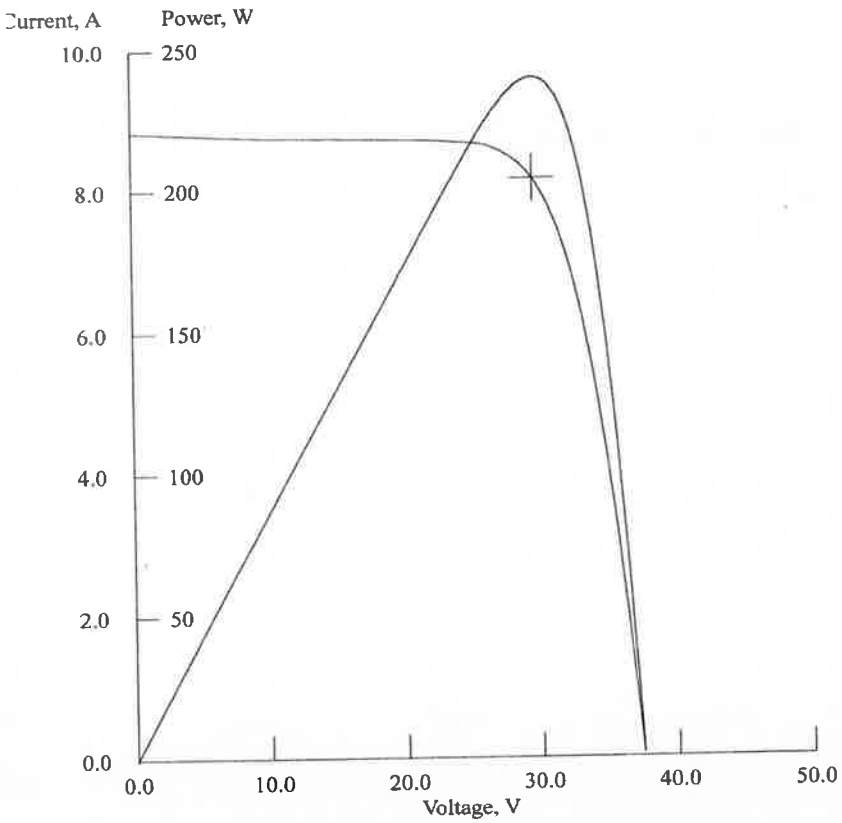


SPI-Sun Simulator 4600 SLP

Title: KL SOLAR
Comment: PRE SALT MIST
Operator: Admin
ID: 1733078
Module Type: ModuleType1
09:50:42 10/14/2013
Measured Temperature = 24.2°C
Corrected Temperature = 25.0°C
Irr Meas = 99.9mW/cm²
Irr Corr = 100.0mW/cm²
Voc = 37.150V
Isc = 8.739A
Pmax = 237.192W
Vpm = 29.491V
Ipm = 8.043A
FF = 0.731
Eff,m = 14.609%
Eff,c = 16.244%
Rs = 0.517 Ohm
Rsh = 79.276 Ohm

Intensity V: 5.342 V
Load Voltage: 6.000 V
Sweep Direction: Isc->Voc
IV Points: 3680

Schematic Diagrams (Sample 1 PIV Graph after Salt Mist Test)



SPI-Sun Simulator 4600 SLP

Title: KL SOLAR
Comment: POST SALT
Operator: Admin
ID: 1733078
Module Type: ModuleType1
15:42:39 10/18/2013
Measured Temperature = 24.1°C
Irr Meas = 100.0mW/cm²
Irr Corr = 100.0mW/cm²
Voc = 37.202V
Isc = 8.831A
Pmax = 239.611W
Vpm = 29.403V
Ipm = 8.149A
FF = 0.729
Eff,m = 14.702%
Eff,c = 16.410%
Rs = 0.492 Ohm
Rsh = 93.695 Ohm

Intensity V: 5.411 V
Load Voltage: 6.100 V
Sweep Direction: Isc->Voc
IV Points: 3666

******End of Report******