

Aim: The objective of the test is to observe the effects of the Specific nano coating applied to non ARC glass (i.e. PFG samples) and also to conduct the Damp Heat test on the specific modules and observe its effects on the Power of the Module.

Modules:		P initial	
PFG10610N9T3I2W30001	- PFG, NSP cells	232.917	Diamon fusion module
PFG10610N9T3I2W30002	- PFG, NSP cells	232.895	Diamon fusion module
S10610Q9T3I2W3002262	- PFG, Q cells	226.237	Production control

Protective Coating applied by Matthew Harding at SDT on the 18 Aug 10

UV pre conditioning of the modules - 1 week

IEC 61215 - Damp-heat test

Purpose:

To determine the ability of the module to withstand the effects of long-term penetration of humidity.

Procedure:

The test shall be carried out in accordance with IEC 60068-2-78 with the following provisions:

b) Severities

The following severities are applied:

Test temperature: 85 °C ± 2 °C Relative humidity: 85 % ± 5 %

Test duration: 1 000 h

NB: Solairedirect Technologies - Test Duration 1500 h

Requirements:

The requirements are as follows:

a) no interruption of current flow during the test;

b) no evidence of major visual defects, such as:

- broken, cracked, or torn external surfaces, including superstrates, substrates, frames and junction boxes.
- bent or misaligned external surfaces, including superstrates, substrates, frames and junction boxes to the extent that the installation and/or operation of the module would be impaired.
- a crack in a cell the propagation of which could remove more than 10 % of that cell's area from the electrical circuit of the module.
- bubbles or delaminations forming a continuous path between any part of the electrical circuit and the edge of the module.
- loss of mechanical integrity, to the extent that the installation and/or operation of the module would be impaired.

c) the degradation of maximum output power shall not exceed 5 % of the value measured before the test;

d) insulation resistance shall meet the same requirements as for the initial measurements.

Results:

Modules:		P initial	P Coating	P UV cond.	P DH 800 hrs	W Variance	% Variance
PFG10610N9T3I2W30001	- PFG, NSP cells	232.917	234.218	232.686	231.979	0.71	0.30
PFG10610N9T3I2W30002	- PFG, NSP cells	232.895	234.092	232.92	232.803	0.12	0.05
S10610Q9T3I2W3002262	- PFG, Q cells	226.237	226.237	225.257	225.158	0.10	0.04

General Comments for first 800 hrs Damp Heat test:

a) First run of 800 hrs, all modules still in good condition.

b) The Diamon fusion coated modules are visibly much cleaner than the control module from production, water marks only present on the control module without the Diamon fusion coating. (see pictures below)

c) It can be noted that between the initial power of the module and after the Diamon fusion coating is applied there is a consistent gain of more than 1 W, per module.

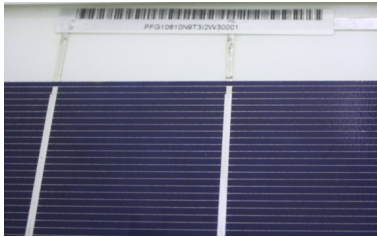
d) After UV preconditioning there is however a loss of approximately 1 W on each of the modules.

Before starting the next run of the Damp heat test, a refresh coat of the Diamon fusion is applied onto the two modules.

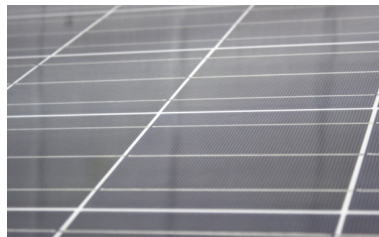
Modules:		P DH 800 hrs	P DH 1200 hrs	% Variance	P DH 1500 hrs	W Variance from P initial	% Variance
PFG10610N9T3I2W30001	- PFG, NSP cells	231.979	231.571	0.48%	220.573	12.11	DH 1500 hrs 5.20%
PFG10610N9T3I2W30002	- PFG, NSP cells	232.803	231.326	0.68%	-	1.59	DH 1200 hrs 0.68%
S10610Q9T3I2W3002262	- PFG, Q cells	225.158	225.034	0.10%	-	0.22	DH 1200 hrs 0.10%

General Comments final 700 hrs of the Damp Heat test:

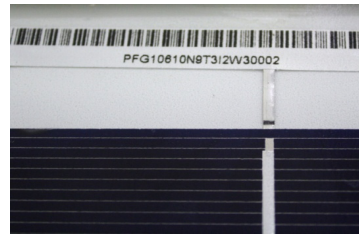
Modules removed after 500 hrs - total test period thus far 1200 hrs (Visual inspection) and refresh Diamon fusion coating applied



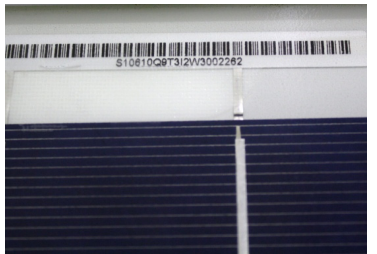
PFG001 - Diamon Fusion coated



PFG001 - Diamon Fusion coated



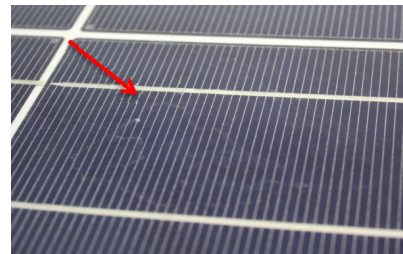
PFG002 - Diamon Fusion coated



PFG2262 - No Diamon Fusion coating



PFG2262 - No Diamon Fusion coating



PFG2262 - No Diamon Fusion coating

- a) It can clearly be noted that there is a visual difference between having the coating applied to the solar module or no coating, the module remains cleaner and therefore can continue to perform at its optimum efficiency.
- b) After 1200 Hrs of testing, PFG002 and PFG2262 had to be removed from testing as there was a default within the module.
- c) PFG001 had completed the 1500 hrs Damp Heat test, and had a total loss of 5.20 W% from Initial Power
- d) It can also be noted that at 1200 Hrs of testing the production control module had the least percentage loss of power from initial value.

Conclusion:

It is very clear that in terms of visual performance the Diamon Fusion coating has an immediate effect on the module, the durability of the coating is also good, after 800 hrs the coating is still present on the module. The longer the coating last on the module, the cleaner the module will be, therefore the more efficient the module will be, providing a peak consistent performance. However the method of direct coating application per module is very time consuming. If the process can be adapted in - line, it may be a viable option for the future.