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Ref: DRW-20-1203

16/11/2020

JA Solar Australia Pty Ltd
Melbourne, Victoria

Attention: Mr Andrew Zhai

RE: **Wind Pressure Testing of JA Solar Crystalline Silicon Photovoltaic Modules**
Type JAM60S20-370/MR/1000V (370W)
Design Certification

Dear Sir,

This Report certifies the Design Wind Pressure for the JA Solar Type JAM60S20-370/MR/1000V PV Module for wind loads in Cyclonic Regions (C & D). We verify that the PV Module are capable of withstanding a design wind load as specified in Table 1.

A pressure test was conducted and observed by this office on the 11th November 2020 in Darwin, Northern Territory. The testing officer was Michael Hatton from this office.

The test modules (serial number 208M6U6025082108 and 208M6U6025087779) were mounted front side up in a test bed. The size of the modules was measured as 1.0 m wide x 1.78 m long. The fixing of the modules was fixed using the Clenergy mounting brackets and rails. The fixings were spaced at 800 mm centres giving a maximum cantilever overhang of 490 mm of the module and 1200 mm centres giving a maximum span for the module. The rails where fixed to the test bed. The perimeter frame of the module is 35 x 35 x 1.2 mm aluminium angle all round.

An air bag was used to apply constant pressure to the back of the module. The air bag was inflated with pressure to the required design pressure and held for 1 minute at maximum pressure.

A calibrated deflection meter was used to measure deflection at mid panel and was recorded at 1 kPa intervals. The electrical continuity of the panels was not measured during the pressure test. The behaviour of the module and supporting fixtures were observed and recorded. Photographs were taken before and at maximum pressure of the test.

A design maximum pressure that was adopted was 12 kPa. This figure was chosen on past tests and it also allows the modules to be placed on the roofs of multi storey buildings subject to the variability factor. The applied factor of variability, for single test specimen and adopting a coefficient of variation of structural characteristics of 10 percent, from AS 1170.0 Table B1 when applying to the allowable design wind capacity is 1.46 even though two tests were done, however they had different support spacings.

The modules sustained a test pressure of 6.5 kPa for the 800 mm support and 6.7 kPa for the 1200 support (short of the design pressure) and showed no signs of cracking of the glass protective covering for the 800 mm support and the glass fracturing for the 1200 mm support. A deflection of 73.9 mm was recorded at mid panel at the 6.5 kPa test pressure for the 800 mm support and a deflection of 66.4mm was recorded at mid panel at the 6.7 kPa test pressure for the 1200 mm support. The test ended at the point where the end frame support was starting to yield for the 800 support test and when the glass fractured for the 1200 support test.

The panels were taken out of the test bed and examined. The 800 support test panel showed signs of permanent distortion of the end cross member of the frame thus indicating the start of yielding of the end member of the frame. We consider that even though the frame started to yield, the panel remained on the test rails with no further damage. We also consider that the fracturing of the glass did not destroy the panel and it still remained intact. We consider the maximum pressure of the module can sustain 6.5 kPa and 6.7 kPa with 800 and 1200 support respectively without forming a debris hazard.

A test observation indicates that the maximum pressures are related to the cantilever ends of the panels rather than the span. This was observed during the test that the cantilever end deflection influences the mid span deflection. It was noted that the larger the cantilever the more influence it has on the mid span deflection. This observation is supported by the end cross member yielding first. However, when the spans increase to a point whereby the span becomes the main influence as observed by the fracturing of the glass protective covering.

Table 1

Module Sn	Support Points (Cantilever)	Max Applied Load	Variability Factor AS 1170.0 Table B1	Ultimate Strength Limit State Design Capacity
208M6U6025082108	800 mm (490 mm)	6.5 kPa	1.46	4.5 kPa
208M6U6025087779	1200 mm (290 mm)	6.7 kPa	1.46	4.6 kPa

We hereby certify the JA Solar Type JAM60S20-370/MR/1000V PV Modules with support points located at 800 mm is suitable for a cyclonic design wind pressure of 4.5 kPa and support points located at 1200 mm a pressure of 4.6 kPa. It is our technical opinion that the same pressure of 4.5 kPa can be maintained with support points at 900 mm. Note that the test is for the PV module only and its support fixings and rails are not part of this test.

This certification excludes the module fixing clamps, the support rail or fixing to the roof as this may limit the maximum design wind pressure.

CERTIFICATION BY STRUCTURAL ENGINEER			
Company Name if certification issued on behalf of a corporation Asset Services Pty Ltd		**Company NT Registration Number** 152941ES	
I certify that reasonable care has been taken to ensure that the structural engineering aspects of the works as described above have been designed in accordance with the requirements of the Building Code of Australia and the Northern Territory Building Regulations.			
Name (see *below) Michael Hatton Nominee for Asset Services Pty Ltd	**Nominee/Individual NT Registration Number** 14704ES	**Signature**	**Date** 16/11/2020

Should you require any further information in relation to this report please contact this office.

Yours faithfully,

Michael Hatton
Senior Structural Engineer | Senior Building Surveyor
Asset Services Pty Ltd