

10 April 2018

Project number: U032_FL2A

Power Ark Solar
C8/391 Park Road
Regents Park NSW 2143

Attention : Johnson Xu.

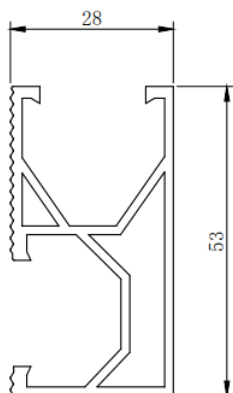
Dear Sir,

RE: POWERARK ROOF MOUNTING FOR LANDSCAPE ORIENTATED
FLUSH MOUNTED SOLAR PANELS

As requested, we have reviewed the structural adequacy of the Aluminum support framing components as detailed in the drawings issued by Powerark Solar. We have design investigated for the Aluminum Railing as shown below. The section of the railing is shown below.

The panels are supported by two rows of railing. The railings are fixed directly to the rafters or to the purlins.

The spacing of the fixing of the Railing to the rafter/purlin shall be limited as tabulated below in tables 1.1, 1.2, 2.1, 2.2, 10.1, 10.2, 20.1, & 20.2 Refer to " List of Tables" below to choose the appropriate span table. Refer to Figure A for wind regions and terrain categories as defined in AS1170.2. The Central & Edge zones referred to in the tables are depicted in figures B on the following pages



1700 X 1100 &
2100X1100
Panels in
Landscape Mode

Two Rows of
Powerark Solar
Railing for each
row of panels

**Railing: Powerark Solar
53x28**

List of Tables:		
Panel Size	Terrain Category 2	Terrain Category 3
1700x1100	1.1 & 1.2 (Page 2)	10.1 & 10.2 (Page 4)
2100x1100	2.1 & 2.2 (Page 3)	20.1 & 20.2 (Page 5)

Terrain Category 2 (TC2) Open terrain, including grassland, with well-scattered obstructions having heights generally from 1.5 m to 5 m, with no more than two obstructions per hectare, e.g. farmland and cleared subdivisions with isolated trees and uncut grass.

Table 1.1 METAL ROOF. Roof Slope: 0 to 15 deg									Terrain Category 2
Maximum spacing (mm) of the fixing of the railing to Pitched METAL roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	2440	2060	1690	1380	870	760	630	520	
10m	2070	1690	1390	1030	810	710	570	460	
15m	1870	1520	1260	880	740	630	500	#N/A	
20m	1760	1440	1170	850	690	570	#N/A	#N/A	
Panel size 1700 X 1100									

Table 1.2 METAL ROOF. Roof Slope: 15 to 30 deg									Terrain Category 2
Maximum spacing (mm) of the fixing of the railing to Pitched METAL& TILED roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	2620	2060	1990	1380	1160	760	710	520	
10m	2410	1690	1630	1030	910	710	660	460	
15m	2200	1520	1470	880	820	630	580	#N/A	
20m	2070	1440	1390	850	760	570	520	#N/A	
Panel size 1700 X 1100									

Flush Mount Landscape Oriented

Terrain Category 2 (TC2) Open terrain, including grassland, with well-scattered obstructions having heights generally from 1.5 m to 5 m, with no more than two obstructions per hectare, e.g. farmland and cleared subdivisions with isolated trees and uncut grass.

Table 2.1 METAL ROOF. Roof Slope: 0 to 15 deg									Terrain Category 2
Maximum spacing (mm) of the fixing of the railing to Pitched METAL roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	1980	1610	1130	1010	770	630	490	#N/A	
10m	1620	1120	1010	880	700	560	440	#N/A	
15m	1420	1050	950	780	590	500	#N/A	#N/A	
20m	1260	1030	910	740	540	#N/A	#N/A	#N/A	
Panel size 2100 X 1100									

Table 2.2 METAL ROOF. Roof Slope: 15 to 30 deg									Terrain Category 2
Maximum spacing (mm) of the fixing of the railing to Pitched METAL& TILED roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	2340	1610	1550	1010	910	630	560	#N/A	
10m	1910	1120	1080	880	810	560	510	#N/A	
15m	1720	1050	1040	780	710	500	450	#N/A	
20m	1620	1030	1010	740	630	#N/A	#N/A	#N/A	
Panel size 2100 X 1100									

Flush Mount Landscape Oriented

Terrain Category 3 (TC3) Terrain with numerous closely spaced obstructions having heights generally from 3 m to 10 m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare, e.g. suburban housing or light industrial estates.

Table 10.1 METAL ROOF.									Terrain Category 3
Roof Slope: 0 to 15 deg									
Maximum spacing (mm) of the fixing of the railing to Pitched METAL roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	2710	2430	2060	1670	1440	1150	810	710	
10m	2710	2430	2060	1670	1100	830	700	590	
15m	2490	2160	1770	1450	870	760	630	520	
20m	2360	1920	1580	1290	760	660	520	#N/A	
Panel size 1700 X 1100									

Table 10.2 METAL & TILED ROOF.									Terrain Category 3
Roof Slope: 15 to 30 deg									
Maximum spacing (mm) of the fixing of the railing to Pitched METAL & TILED roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	2890	2430	2400	1670	1690	1150	910	710	
10m	2890	2430	2400	1670	1350	830	770	590	
15m	2730	2160	2090	1450	1160	760	710	520	
20m	2530	1920	1860	1290	840	660	600	#N/A	
Panel size 1700 X 1100									

Flush Mount Landscape Oriented

Terrain Category 3 (TC3) Terrain with numerous closely spaced obstructions having heights generally from 3 m to 10 m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare, e.g. suburban housing or light industrial estates.

Table 20.1 METAL ROOF.									Terrain Category 3
Roof Slope: 0 to 15 deg									
Maximum spacing (mm) of the fixing of the railing to Pitched METAL roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	2420	1960	1600	1100	1020	910	700	560	
10m	2420	1960	1600	1100	890	720	550	450	
15m	2080	1690	1280	1030	770	630	490	#N/A	
20m	1850	1500	1070	970	620	520	#N/A	#N/A	
Panel size 2100 X 1100									

Table 20.2 METAL & TILED ROOF.									Terrain Category 3
Roof Slope: 15 to 30 deg									
Maximum spacing (mm) of the fixing of the railing to Pitched METAL & TILED roof									
	Region A		Region B		Region C		Region D		
Roof Height	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	Central Zone	Edge Zone	
5m	2880	1960	1890	1100	1120	910	810	560	
10m	2880	1960	1890	1100	1000	720	650	450	
15m	2460	1690	1630	1030	910	630	560	#N/A	
20m	2180	1500	1410	970	740	520	460	#N/A	
Panel size 2100 X 1100									

Flush Mount Landscape Oriented

Our design investigation is based on the following Australian Standards and sections of Building Code of Australia relevant to structural issues.

- AS/NZS 1170.0-2002 Structural design Actions Part 0: General principles.
- AS/NZS 1170.2-2011(R2016) Structural design Actions Part 2: Wind actions.
- AS 1664.1-1997 Aluminum structures Part 1: Limit state design.
- AS/NZS 4673-2001 Cold Formed Stainless Steel.
- AS 1684.1-1999 Residential timber-framed construction - Design criteria.
- AS 1684.2-2010 Residential timber-framed construction - Non-cyclonic areas.
- AS 1684.3-2010 Residential timber-framed construction - Cyclonic areas.
- AS 1720.1-2010 Timber structures - Design methods.pdf.
- AS 3566.1-2002 Self-drilling screws for the building and construction industries.
- AS3566.2-2002 Part 2: Corrosion resistance requirements.
- ISO3506:1-2009 Mechanical Properties of Corrosion-Resistance Stainless Steel Fasteners.

Following design criteria has been used for the structural verification.

- Design Life 25 years
- Importance Level Type 2: Ordinary
- Annual Probability of exceedance 1/200
- Terrain Category to AS1170.2 2 and 3
- Service Deflection Not limited
- Snow loading Not considered
- Earthquake Loading Not considered
- Maximum Roof Pitch 30 degrees
- Minimum pitch for Tiled Roof 15 degrees
- Aluminum Rails 6005 - T5
- Maximum dimensions & Minimum weight of Solar panels
 - 18 Kg panel 1700X1100
 - 25 Kg panel 2100X1100
- Orientation of Panel Landscape

POWERARK ROOF MOUNTING FOR LANDSCAPE ORIENTATED FLUSH MOUNTED SOLAR PANELS

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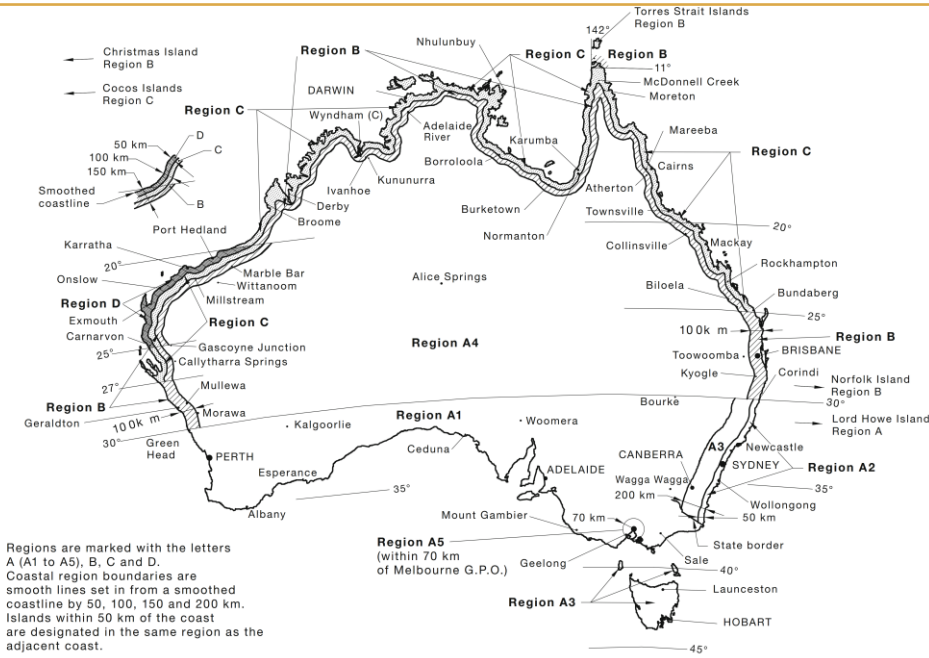


Figure A.

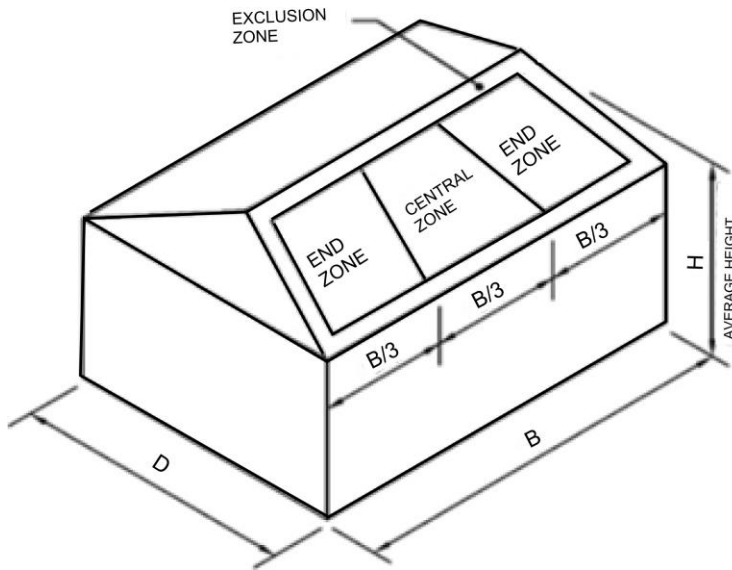
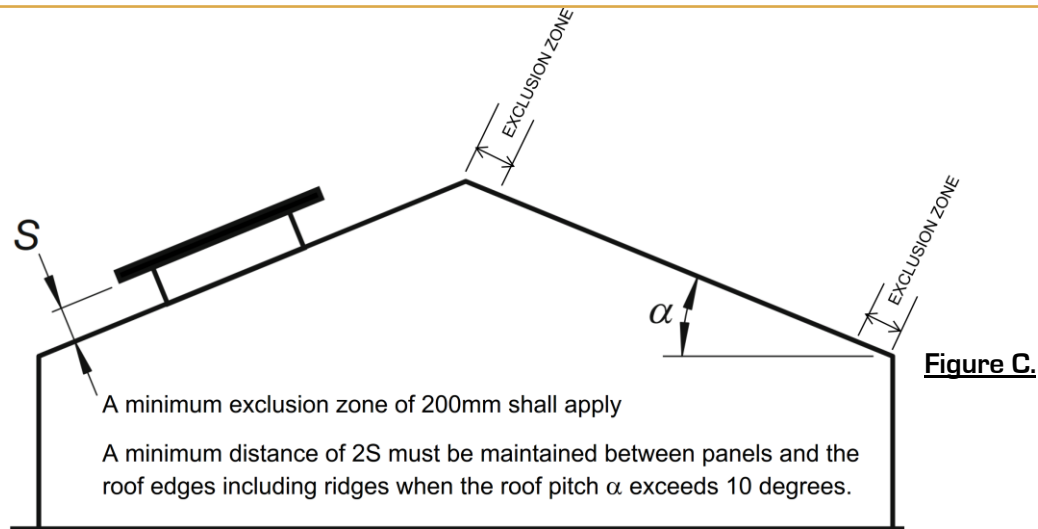


Figure B.



Subject to the following qualifications we certify that the above mentioned frames are structurally adequate and conform to the above Australian standards.

1. The gap between the underside of the solar panels and the roof shall be between 50mm minimum and 300mm maximum. Nominate the actual gap as "S" mm.
2. The solar panels shall be installed 2xS mm or 200 mm (whichever is greater) away from the roof edges and the ridge. Example: If the gap below the panel is 150mm then the panels shall be located 300mm away from the roof edge and the ridge. See Figure C above.
3. Each row of solar panels shall have a minimum of two rows of railing fixed to the roof framing.
4. The connections between the solar panels shall be flexible to accommodate deflection of the railing.
5. The deflection of the railing has not been controlled in the design. If deflection has to be limited then spacing shall be reduced as advised by a practicing structural engineer.
6. The roofing to which the panels are to be installed shall conform to the relevant Australian Standards including AS1684, AS4440, AS1720, AS4100 and AS4600.
7. The buildings to which the panels are to be installed shall be of approved construction and conform to BCA and the relevant Australian Standards. The roof framing and the building shall be regularly maintained as required.
8. The existing roof framing shall be verified for compliance to Clause D6, of AS1170.2.
9. The installation of the framing shall conform to relevant Australian Standards, Manufacturer's specifications and good building practice.

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10. The spacing of the rail fixings shall not exceed the recommended spacing, and shall be reduced to match the location of the roof rafters.
11. The cantilever span of the panel shall not exceed 25% of panel length (i.e. 425mm for 1700 long).
12. The cantilever span of the railing shall not exceed 33% of the adjacent spacing of the installed fixings.
13. Each fixing shall have a minimum of two gauge 14 screws.
14. The screws used to attach the railing to the roof framing shall conform to AS3566, ISO 3506.1.
15. The cold formed steel purlins shall have a minimum base material thickness of 1.2mm in Regions A & B and 1.9mm in Regions C & D.

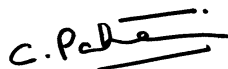
16. The Minimum Timber Joint Type classification shall be as follows:

Wind Regions	Seasoned	Unseasoned	Joint Classification as in Tables H2.3 & H3.1 of AS1720.1.
A & B	JD1 to JD5	J1 to J4	
C & D	JD1 to JD4	J1 to J3	

17. Predrilled holes shall be used for all screw fixings into timber. The width of Timber purlins shall not be less than 35mm. The minimum embedment for each screw shall be 35mm. Minimum edge distance for screws shall be 17mm.
18. Dissimilar metals shall be separated with a suitable inert material to prevent galvanic corrosion.
19. The installation and fixings shall be periodically inspected and maintained.
20. The following are excluded from this certification.
 - x Framing of the solar panel assembly.
 - x Material Testing and or Verification of test certificates for the materials and components.

Should you have any queries, please feel free to call Paheer on 9565-5558.

Yours faithfully,
SPAD PTY LTD



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Director