

14 December 2020

Project number: V039

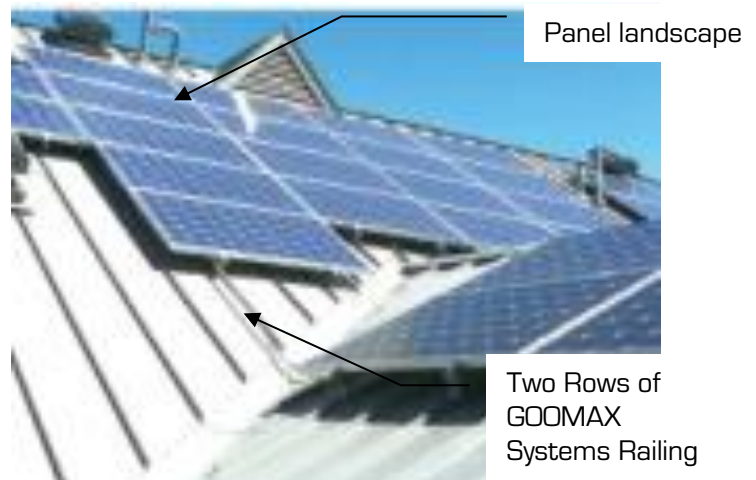
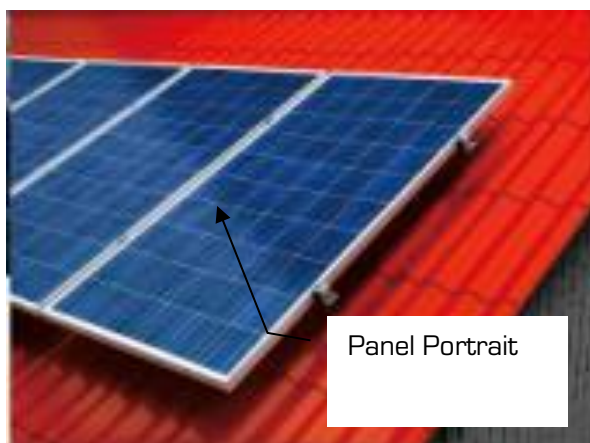
Xiamen GOOMAX Energy Technology Co., Ltd
No. 905 JORDAN BUILDING, HIGH-TECH PARK, HULI DISTRICT
XIAMEN City
FUJIAN Province China,361011

Dear Sir/Madam,

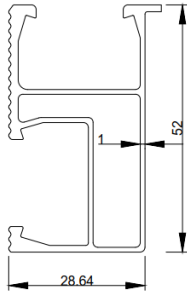
RE: GOOMAX ROOF MOUNTING FOR PORTRAIT AND LANDSCAPE
ORIENTATED FLUSH MOUNTED SOLAR PANELS ON TILE ROOF

As Requested, we have reviewed the structural adequacy of the Aluminum support framing components as detailed in the drawings issued by GOOMAX. We have design investigated support framing for the Aluminum Railing GM-RO1-Light, GM-R56, GM-R69 sections as shown below on page 2 and using the material specifications and test reports supplied by the manufacturer. We reduced the design pull out capacity to the capacity given in the test report. The certification and the recommended spacings are applicable for any of the listed railing and components.

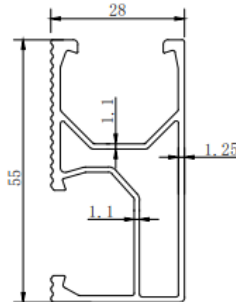
The panels are supported by two rows of railing that are fixed to the rafters of the tiled roofs. The railings are attached to the tile hooks that are screw fixed to the timber rafters. The spacing of the fixing of the Railing to the rafter shall be limited to the tabulated values in tables 1.1, 1.2, 2.1, 2.2, 3.1 & 3.2. Refer to " List of Tables" below on page 3 to choose the appropriate span table. Refer to Figure A for wind regions and terrain categories as defined in AS/NZS 1170.2. The Central & Edge zones referred to in the tables are depicted in figures B and C on the following pages.



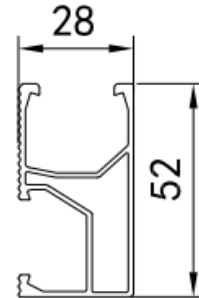
GOOMAX ROOF MOUNTING FOR PORTRAIT AND LANDSCAPE ORIENTATED FLUSH MOUNTED SOLAR PANELS ON TILE ROOF



Railing: GM-R01-Light



Railing: GM-R56



Railing: GM-R69

Goomax Solar Rail Sections

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.



GOOMAX ROOF MOUNTING FOR PORTRAIT AND LANDSCAPE ORIENTATED FLUSH MOUNTED SOLAR PANELS ON TILE ROOF

Panel Size	Portrait	Landscape
1700x1000	1.1 (Page 3)	1.2 (Page 3)
2000x1000	2.1 (Page 4)	2.2 (Page 4)
2250x1120	3.1 (Page 5)	3.2 (Page 5)

Table 1.1 TILED ROOF. Roof Slope: 15 to 35 deg								
Maximum spacing (mm) of the fixing of the railing to Pitched 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	2350	1960	1930	1660	1390	1040	910	570
10m	2120	1800	1780	1370	1330	930	760	520
15m	2020	1740	1720	1300	1080	740	690	340
20m	1960	1700	1670	1220	1040	670	570	#N/A
Panel size 1700 X 1000								

Portrait oriented

Table 1.2 TILE ROOF. Roof Slope: 15 to 35 deg								
Maximum spacing (mm) of the fixing of the railing to Pitched 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	2850	2290	2260	1610	1350	840	780	570
10m	2560	1850	1830	1330	1240	780	730	510
15m	2460	1680	1660	1090	930	710	640	320
20m	2400	1640	1610	1000	840	630	570	#N/A
Panel size 1700 X 1000								

Landscape oriented

GOOMAX ROOF MOUNTING FOR PORTRAIT AND LANDSCAPE ORIENTATED FLUSH MOUNTED SOLAR PANELS ON TILE ROOF

Table 2.1 TILED ROOF. Roof Slope: 15 to 35 deg								
Maximum spacing (mm) of the fixing of the railing to Pitched 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	2160	1830	1800	1380	1260	780	730	490
10m	1970	1700	1660	1220	1070	730	620	320
15m	1880	1580	1550	1060	990	580	550	#N/A
20m	1830	1520	1390	1040	780	540	490	#N/A
Panel size 2000 X 1000								

Portrait oriented

Table 2.2 TILE ROOF. Roof Slope: 15 to 35 deg								
Maximum spacing (mm) of the fixing of the railing to Pitched 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	2820	1930	1900	1130	1030	770	710	430
10m	2260	1630	1560	1010	980	700	630	340
15m	1990	1350	1310	950	860	600	520	#N/A
20m	1930	1180	1150	910	770	510	430	#N/A
Panel size 2000 X 1000								

Landscape oriented

#N/A : Failure of screw fixing to rafters.

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Table 3.1 TILED ROOF. Roof Slope: 15 to 35 deg								
Maximum spacing (mm) of the fixing of the railing to Pitched 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	1890	1580	1550	1060	940	560	510	#N/A
10m	1740	1300	1300	790	760	510	460	#N/A
15m	1660	1200	1080	740	680	330	#N/A	#N/A
20m	1590	1070	1060	710	570	#N/A	#N/A	#N/A
Panel size 2250 X 1200								

Portrait oriented

Table 3.2 TILE ROOF. Roof Slope: 15 to 35 deg								
Maximum spacing (mm) of the fixing of the railing to Pitched 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	2100	1350	1310	950	790	540	490	#N/A
10m	1670	1050	1040	780	760	480	380	#N/A
15m	1560	1010	1000	720	640	350	#N/A	#N/A
20m	1360	970	960	680	540	#N/A	#N/A	#N/A
Panel size 2250 X 1200								

Landscape oriented

#N/A : Failure of screw fixing to rafters.

GOOMAX ROOF MOUNTING FOR PORTRAIT AND LANDSCAPE ORIENTATED FLUSH MOUNTED SOLAR PANELS ON TILE ROOF

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 AS/NZS1170.2 2 and 3
- Service Deflection Not limited
- Snow loading Not considered
- Earthquake Loading Not considered
- Maximum Roof Pitch 35 degrees
- Minimum pitch for Tiled Roof 15 degrees (As required by NCC)
- Aluminum Rails 6005 - T5
- Maximum dimensions & Minimum weight of Solar panels.
 - 17 Kg panel 1700X1000
 - 20 Kg panel 2000X1000
 - 27 Kg panel 2250X1200
- Panel Orientation Landscape and Portrait.

GOOMAX ROOF MOUNTING FOR PORTRAIT AND LANDSCAPE ORIENTATED FLUSH MOUNTED SOLAR PANELS ON TILE ROOF

The Components related to this certificate are listed below:

Rail	GM-R56, GM-RO1-LIGHT, GM-R69
Rail Joiner	GM-RS-51-AZ (Direct conductive), GM-RS-51-AZ-1 GM-RS-56-AZ
Tile Roof Hook	GM-CTH-01-AZ-02, GM-CTH-01-P, GM-CTH-11-AZ, GM-CTH-10-AZ
Mild Clamp	GM-MC-30-AZ GM-MC-35-AZ GM-MC-40-AZ GM-MC-45-AZ GM-MC-50-AZ GM-MC-30(35)-AZ GM-MC-30(40)-AZ
Adjust Mild Clamp	GM-MC-35(40)-AZ, GM-MC-35(40)-AZ-1 GM-MC-35(40)-AZ-2, GM-MC-35/50-D
Adjust End Clamp	GM-EC-30(40)-AZ GM-EC-35(40)-AZ GM-EC-35/50-D
Universal Mid/End Clamp	GM-E/MC-30(40)-AZ
Thin Film Mild Clamp	GM-MC-60-TF2
Thin Film End Clamp	GM-EC-60-TF2
End Clamp	GM-EC-30(35)-AZ GM-EC-30-AZ GM-EC-35-AZ GM-EC-40-AZ GM-EC-45-AZ GM-EC-50-AZ
RAIL CLAMP	GM-BR-02-AZ
T Nut	GM-BN-25-AZ
Wood Screw	SC6.3X65-AZ

The following non-structural components are used with the framing.

Cable Clip :	GM-SL-XJ-AZ, GM-XJ-AZ GM-CT-AZ
Earthing Clip ,:	GM-E-EL-AZ, GM-E-EL-12
Grounding Lug :	GM-EK-AZ

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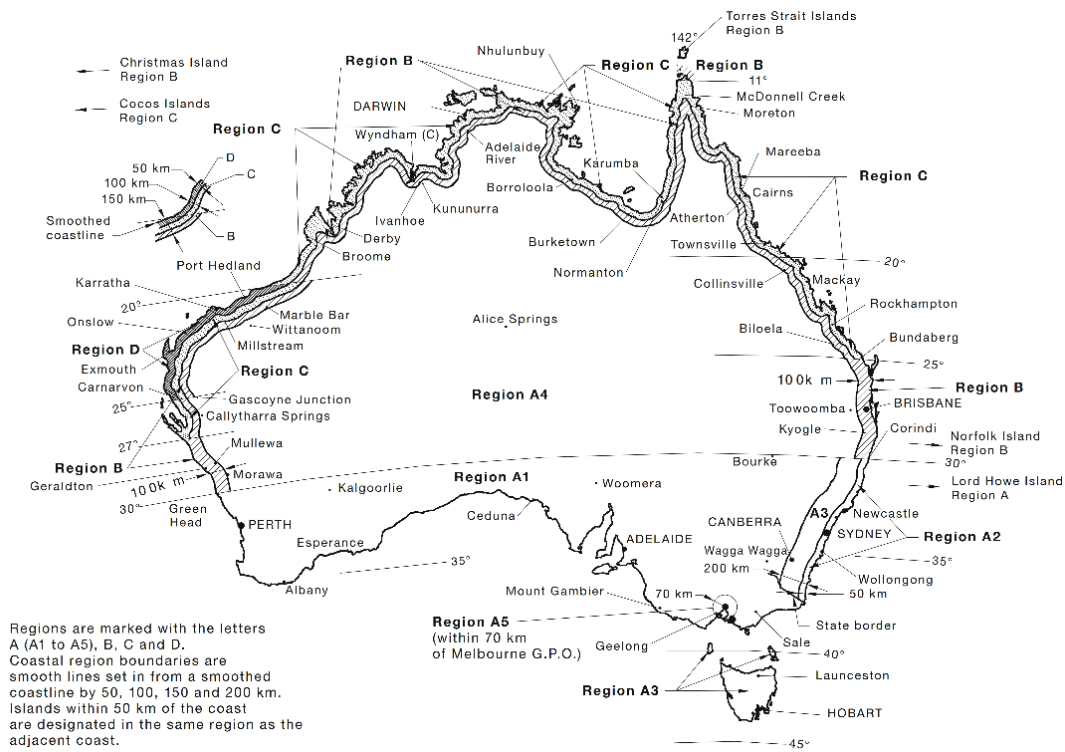


Figure A.

GOOMAX ROOF MOUNTING FOR PORTRAIT AND LANDSCAPE ORIENTATED FLUSH MOUNTED SOLAR PANELS ON TILE ROOF

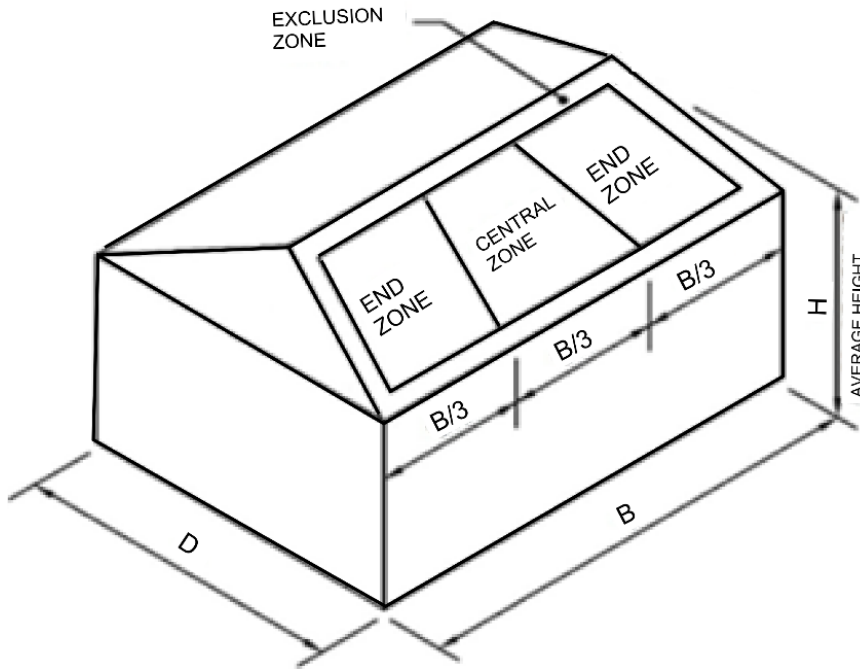


Figure B.

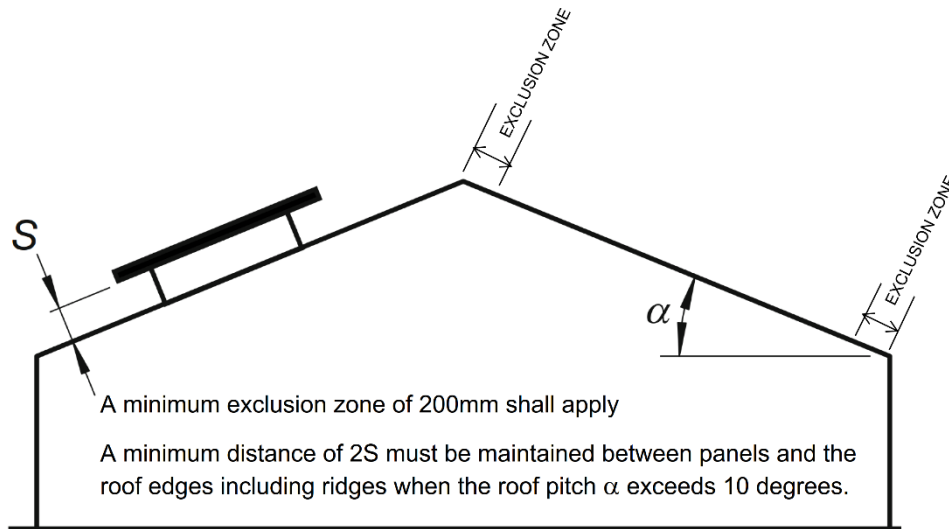


Figure C.

GOOMAX ROOF MOUNTING FOR PORTRAIT AND LANDSCAPE ORIENTATED FLUSH MOUNTED SOLAR PANELS ON TILE ROOF

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 N.C.C and 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 AS/NZS1170.2.
9. The installation of the framing shall conform to relevant Australian Standards, Manufacturer's specifications and good building practice.
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.

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GOOMAX ROOF MOUNTING FOR PORTRAIT AND LANDSCAPE ORIENTATED FLUSH MOUNTED SOLAR PANELS ON TILE ROOF

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

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

16. Predrilled holes shall be used for all screw fixings into timber. The width of Timber rafters shall not be less than 35mm. Minimum edge distance for screws shall be 17mm. The minimum embedment for each screw shall be 35mm.

17. Dissimilar metals shall be separated with a suitable inert material to prevent galvanic corrosion.

18. The installation and fixings shall be periodically inspected and maintained.

19. 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

Paheer C Paheerathan
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Director