



**EBULEN CONSULT**

# **SOLAR PV ROOF-MOUNT RACKING FRAME ENGINEERING CERTIFICATE**

**GOOMAX FLUSH-MOUNT SYSTEM WITH PENETRATIVE FIXING & L-FOOT**

Prepared for:

**Xiamen Goomax Energy Technology Co., Ltd.**

Suite 905, Jordan Building A, High-tech Park, Huli District

Xiamen, China

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Ref: E22050549

## OVERVIEW

This structural engineering certificate is issued for Goomax Tilt Leg racking system, which is assessed against relevant Australian Standards and regulations. The assessment is carried out based on sound engineering methodologies. Assessment specifications and findings are given in the following sections.

## AUSTRALIAN STANDARDS

- AS/NZS 1170.0:2002 – Structural design actions, Part 0: General principles
- AS/NZS 1170.1:2002 (R2016) – Structural design actions, Part 1: Permanent, imposed and other actions
- AS/NZS 1170.2:2021 – Structural design actions, Part 2: Wind actions
- AS/NZS 1664:1997 – Aluminum Structures
- AS/NZS 4600:2018 – Cold-Formed Steel Structures
- AS1720.1:2010 – Timber structures – Design methods
- AS 3600:2018 – Concrete Structures

## ASSESSED PV RACKING FRAME COMPONENTS

The following products by Xiamen Goomax Energy Technology Co., Ltd. are assessed against relevant Australian Standards and building regulations based on the specified conditions.

Assessed Components	Component Number	Material
Goomax Rail 1	GM-R56	AL 6005-T5
Goomax Rail 2	GM-R69 (GM-R69-B)	AL 6005-T5
Goomax Rail 3	GM-R01-Light	AL 6005-T5
Goomax Rail Joiner 1	GM-RS-51-AZ	AL 6005-T5
Goomax Rail Joiner 2	GM-RS-51-AZ-1	AL 6005-T5
Goomax Rail Joiner 3	GM-RS-56-AZ/GM-RS-56-AZ-B	AL 6005-T5
Goomax Rail Connector	GM-BR-02-AZ	AL 6005-T5
Goomax Middle Panel Clamp	GM-MC-30/35/40/45/50-AZ	AL 6005-T5
Goomax End Panel Clamp	GM-EC-30/35/40/45/50-AZ	AL 6005-T5
Goomax Adjustable Middle Panel Clamp	GM-MC-30(35)-AZ, GM-MC-30(40)-AZ, GM-MC-35(40)-AZ, GM-MC-35(40)-AZ-1, GM-MC-35(40)-AZ-2, GM-MC-35/50-D, GM-MC-30(35)-AZ-2	AL 6005-T5
Goomax Adjustable End Panel Clamp	GM-EC-30(35)-AZ, GM-EC-30(40)-AZ, GM-EC-35(40)-AZ, GM-EC-35/50-D	AL 6005-T5

Goomax Thin Film Panel Middle Clamp	GM-MC-60-TF2-AZ	AL 6005-T5
Goomax Thin Film Panel End Clamp	GM-EC-60-TF2-AZ	AL 6005-T5
Goomax T-nut	GM-BN-25-AZ	AL 6005-T5
Goomax L-foot Bracket 1	GM-MRH-L5-AZ	AL 6005-T5
Goomax L-foot Bracket 2	GM-MRH-L5-AZ-02	AL 6005-T5
Goomax L-foot Bracket 3	GM-MRH-YCJ-AZ, GM-MRH-L5-YCJ-AZ-D	AL 6005-T5
Other Required but Non-structural Components	GM-E-EL-AZ, GM-EK-AZ, GM-SLXJ-AZ, GM-XJ-AZ, GM-E-EL-12, GM-CT-AZ	SUS 304, Plastic

**Note:** the materials listed in the table refer to the main components and members of the racking frame, other accessories such as nuts, bolts, washers, and sockets are made of SUS 304.

## ASSESSMENT CONDITIONS

- Solar PV system design life of 25 years
- Wind region A, B, C, D
- Terrain category 2 & 3
- Ultimate wind recurrence interval of 200 years
- Maximum average roof height of 30m
- Maximum panel tilt angle to roof surface is 30°
- Solar PV panel assessed: 2000mm x 1200mm, 2274mm x 1200mm, 2400mm x 1200mm and 1670mm x 1000mm
- Self-weight of solar PV panel and racking frame is 0.15kPa-0.19kPa
- Solar PV panel is supported by minimum 2 rails
- Screw fixing pull-out has been checked with insert into minimum 35mm JD4 timber structure and steel structure with thicknesses of 1.2mm, 1.5mm, 1.9mm and 2.4mm
- Concrete anchor fixing has been checked with chemical and mechanical anchoring options
- Product details are taken from the drawing set provided by Xiamen Goomax Energy Technology Co., Ltd. as listed in the above component table
- Installation to be carried out strictly in accordance with the manufacturer's installation guidelines

## IMPORTANT NOTES

- ***This certification is issued based on assessments of solar PV racking frame system and its fixing connection to building roof. It has not considered the structural capacity of building structure and solar PV panel due to uncertainty of generic application. The installer must use the data tables as references only.***
- ***The attached spacing tables must be read in conjunction with foot notes and general notes.***
- ***The non-structural components are only certified structurally using the deem-to-comply method as they do not contribute to the system's structural capacity.***
- ***The certificate shall be read as a whole. Any section, text, image, table extracted from this certification is not valid stand-alone.***
- ***This certification shall be reviewed and revalidated by the structural engineer after two years from the date of issue or if any applicable standard is updated.***

## CONCLUSION

The above-mentioned solar PV roof-mount racking frame system by Xiamen Goomax Energy Technology Co., Ltd. is found structurally sound against relevant Australian Standards following the engineering recommendations in this certification. Installation shall be conducted following the manufacturer's guidelines.

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## APPENDIX A – INSTALLATION GUIDELINE FOR 2M X 1.2M PV PANEL

**Interface Spacing Table for Terrain Category 3,  $h/d \leq 0.5$  (Unit: mm)**

Wind Region	Roof Height	$H \leq 10m$	$10m < H \leq 15m$	$15m < H \leq 20m$
A	Internal Zone	1800	1800	1800
	Intermediate Zone	1767	1632	1535
	Edge Zone	1503	1407	1325
	Corner Zone	1151	992	883
B	Internal Zone	1793	1655	1557
	Intermediate Zone	1446	1363	1233
	Edge Zone	1182	1019	907
	Corner Zone	770	665	594
C	Internal Zone	1276	1096	974
	Intermediate Zone	824	711	633
	Edge Zone	608	526	469
	Corner Zone	399	346*	309*
D	Internal Zone	807	696	621
	Intermediate Zone	527	456	407
	Edge Zone	391	339*	303*
	Corner Zone	258*	224*	200*

NOTES:

- \* denotes the situations where the wind load is more than 5KPa and the installation safety is compromised.
- Definition of Terrain Category is given in General Note 1.
- Notion of Roof Zone is given in General Note 2.
- Roof pitch angle is given in reference to horizontal.
- The spacing table is based on the fixing condition specified in General Note 7.

**Interface Spacing Table for Terrain Category 3,  $h/d \geq 1$  (Unit: mm)**

Wind Region	Roof Height	$H \leq 10m$	$10m < H \leq 15m$	$15m < H \leq 20m$
A	Internal Zone	1800	1667	1567
	Intermediate Zone	1454	1346	1249
	Edge Zone	1198	1032	919
	Corner Zone	780	674	601
B	Internal Zone	1469	1386	1284
	Intermediate Zone	1085	936	834
	Edge Zone	801	692	617
	Corner Zone	525	455	406*
C	Internal Zone	858	740	659
	Intermediate Zone	559	484	432
	Edge Zone	415	359	321*
	Corner Zone	274*	237*	212*
D	Internal Zone	548	474	424
	Intermediate Zone	360	312*	279*
	Edge Zone	268*	233*	208*
	Corner Zone	178*	154*	138*

NOTES:

- \* denotes the situations where the wind load is more than 5KPa and the installation safety is compromised.
- Definition of Terrain Category is given in General Note 1.
- Notion of Roof Zone is given in General Note 2.
- Roof pitch angle is given in reference to horizontal.
- The spacing table is based on the fixing condition specified in General Note 7.

<b>Interface Spacing Table for Terrain Category 2, <math>h/d \leq 0.5</math> (Unit: mm)</b>				
Wind Region	Roof Height	H $\leq$ 10m	10m<H $\leq$ 15m	15m<H $\leq$ 20m
A	Internal Zone	1800	1702	1649
	Intermediate Zone	1451	1374	1332
	Edge Zone	1192	1074	1011
	Corner Zone	776	700	660
B	Internal Zone	1466	1408	1374
	Intermediate Zone	1080	973	917
	Edge Zone	796	719	678
	Corner Zone	522	472	446
C	Internal Zone	853	769	725
	Intermediate Zone	557	503	474
	Edge Zone	413	373	352*
	Corner Zone	272*	246*	233*
D	Internal Zone	546	493	465
	Intermediate Zone	359	324*	306*
	Edge Zone	267*	242*	228*
	Corner Zone	177*	160*	151*

NOTES:

1. \* denotes the situations where the wind load is more than 5KPa and the installation safety is compromised.
2. Definition of Terrain Category is given in General Note 1.
3. Notion of Roof Zone is given in General Note 2.
4. Roof pitch angle is given in reference to horizontal.
5. The spacing table is based on the fixing condition specified in General Note 7.

<b>Interface Spacing Table for Terrain Category 2, <math>h/d \geq 1</math> (Unit: mm)</b>				
Wind Region	Roof Height	H $\leq$ 10m	10m<H $\leq$ 15m	15m<H $\leq$ 20m
A	Internal Zone	1474	1403	1360
	Intermediate Zone	1094	986	929
	Edge Zone	807	729	687
	Corner Zone	529	478	451
B	Internal Zone	1124	1013	954
	Intermediate Zone	732	662	624
	Edge Zone	543	491	463
	Corner Zone	358*	324*	306*
C	Internal Zone	579	523	493
	Intermediate Zone	380	344*	325*
	Edge Zone	283*	256*	242*
	Corner Zone	187*	169*	160*
D	Internal Zone	373	337*	318*
	Intermediate Zone	246*	223*	210*
	Edge Zone	184*	166*	157*
	Corner Zone	122*	110*	104*

NOTES:

1. \* denotes the situations where the wind load is more than 5KPa and the installation safety is compromised.
2. Definition of Terrain Category is given in General Note 1.
3. Notion of Roof Zone is given in General Note 2.
4. Roof pitch angle is given in reference to horizontal.
5. The spacing table is based on the fixing condition specified in General Note 7.

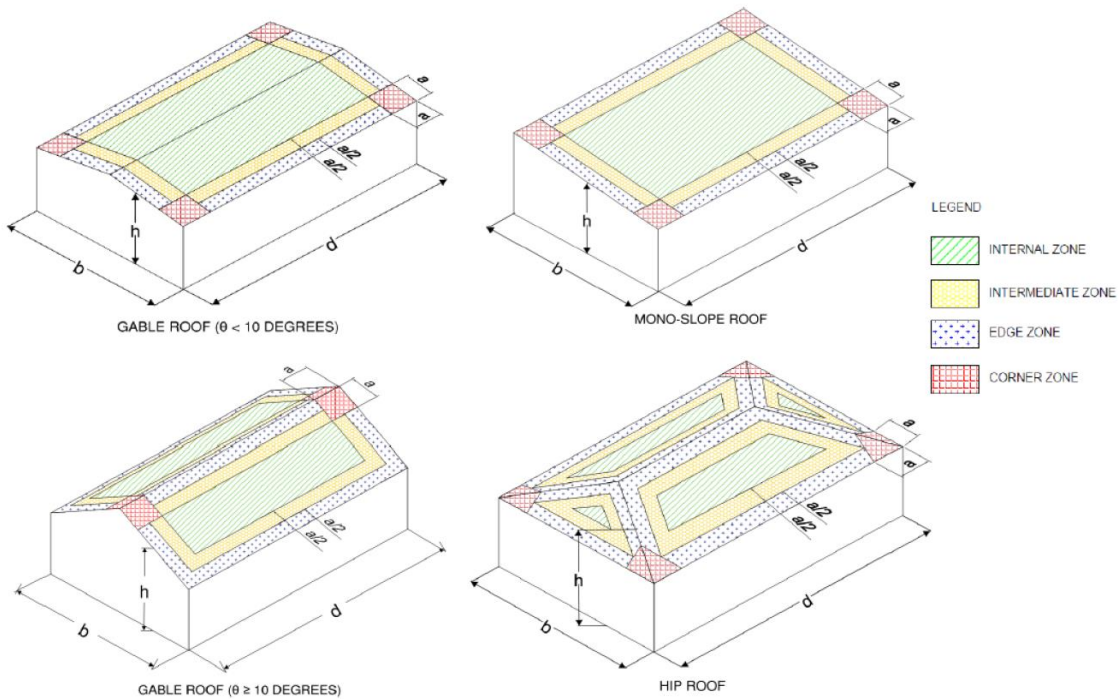
## General Notes

**Note 1** Terrain Category 3 (TC 3) denotes terrain with numerous closely spaced obstructions having heights generally from 3m to 10m. The minimum density of obstructions shall be at least the equivalent of 10 house-size obstructions per hectare.

Terrain Category 2 (TC 2) denotes open terrain, including grassland, with well-scattered obstructions having heights generally from 1.5m to 5m, with no more than two obstructions per hectare.

Refer to AS/NZS 1170.2:2021 - 4.2.1 for Terrain Category definitions.

**Note 2** Notion of Roof Zone example (for roof pitch  $\leq 10$  degrees case) is as shown in the following figure.

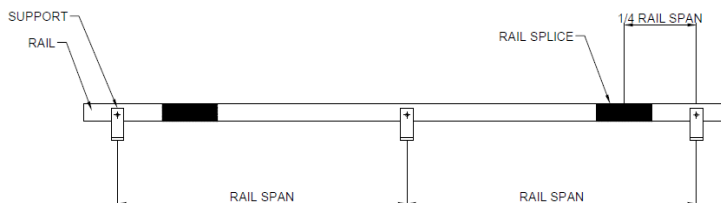


Refer to AS/NZS 1170.2:2021 – Chapter 5.4.4 for more accurate Roof Zone notion and cases.

To determine the zone dimension "a", follow the steps:

- 1) Determine building height (h), building length (b) and building width (d).
- 2) Determine (h/d) and (h/b)
- 3) If (h/b) or (h/d)  $\geq 0.2$ , a is the minimum of 0.2b or 0.2d
- 4) If (h/b) and (h/d)  $< 0.2$ , a is equal to 2h

**Note 3** To ensure the fixing spacing in above tables are valid, rail splice connectors must not be installed at the support point or at the middle span point between two adjacent supports. It is recommended to install the connector at 1/4 span points from the supports.





**Note 4** Number of panel clamps required per panel for installation:

		TC3			TC2		
		H≤10m	10m<H≤15m	15m<H≤20m	H≤10m	10m<H≤15m	15m<H≤20m
Region A	Internal	4	4	4	4	4	4
	Intermediate	4	4	4	4	4	4
	Edge	4	4	4	4	4	6
	Corner	4	6	6	6	NA	NA
Region B	Internal	4	4	4	4	4	4
	Intermediate	4	4	4	6	6	6
	Edge	4	6	6	6	NA	NA
	Corner	6	NA	NA	NA	NA	NA
Region C	Internal	4	4	4	4	6	6
	Intermediate	6	6	6	6	NA	NA
	Edge	NA	NA	NA	NA	NA	NA
	Corner	NA	NA	NA	NA	NA	NA
Region D	Internal	6	6	NA	NA	NA	NA
	Intermediate	NA	NA	NA	NA	NA	NA
	Edge	NA	NA	NA	NA	NA	NA
	Corner	NA	NA	NA	NA	NA	NA

Notes:

1. NA denotes the situations where an excessive amount of panel clamps are required and the installation is no longer practical.
2. A site-specific engineering assessment must be carried out to determine the number of panel clamps required for situations not covered in this table.

**Note 5** The provided installation spacing tables are based on maximum PV panel size of 2000mm x 1200mm with 2 rails per panel array. For other panel sizes and more rails, refer the below table for adjustment factors based on the given spacing tables.

Maximum Panel Size	Number of Rails	Spacing Adjustment Factor
2400x1200	2 rails	83%
2274x1200	2 rails	88%
1670x1000	2 rails	119%
2000x1200	3 rails	150%
2400x1200	3 rails	125%
2274x1200	3 rails	132%
1670x1000	3 rails	179%

The maximum allowable fixing spacing shall not exceed 1800mm after applying the adjustment factors.

**Note 6** The spacing results in previous sections are given based on the corrosivity level C3. Corrosivity adjustment factor for corrosivity category C4 based on the corrosivity category C3 is 95%

**Note 7** Fixing spacing in the above tables are based on 1 x 14 gauge penetrative screw fixing pull-out capacity into 1.9BMT steel and 35mm embedded into JD4 seasoned timber. The fixing spacing must be adjusted if the roof structure being fixed into a different substructure. The recommended typical penetrative fixings to be adopted are as following:

Steel purlin/batten	-	14g-10TPI Self-drilling Tek Metal Screw (Buildex recommended)
Timber purlin/batten	-	14g-10TPI Self-drilling T17s Timber Screw (Buildex recommended)

Larger diameter new screws (14 gauge typical) shall be used for solar installation to replace the old roof screws (12gauge typical). All self-drilling penetrative fixing must be in compliance with AS3566-2002(R2015).

For fixing into steel roof structure with different thicknesses, refer below for adjustment factors based on the given spacing tables.

1) 1.2mm BMT:	63%
2) 1.5mm BMT:	79%
3) 2.4mm BMT:	100% for region A and B, 126% for region C and D
4) 0.42mm BMT (with 550MPa yield strength) :	25%
5) 0.48mm BMT (with 550MPa yield strength) :	29%
6) 0.55mm BMT (with 550MPa yield strength) :	33%
6) 0.75mm BMT (with 550MPa yield strength) :	45%

When installing on concrete roof, adopt concrete chemical or mechanical anchor as per the anchor manufacturer's specifications. The recommended concrete fixing anchors are as below:

Chemical anchor	-	M8/M10 G5.8 galvanised anchor stud with Chemset Reo502 PLUS or approved equivalent; Minimum embedment depth 70mm
Mechanical anchor	-	M8/M10 DynaBolt PLUS DP08065SS or DP10075GH or approved equivalent; Minimum embedment depth 35mm/45mm

For fixing into concrete roofs, refer below for adjustment factors based on the given spacing tables.  
 100% for Region A&B; 160% for Region C&D

**Note 8** All above-mentioned adjustment factors from different notes shall not be applied together to determine the final installation spacing. Factors from each note shall be applied independently. For example, when installing the racking frame with 2000mm x 1100mm panels and 3 rails fixed to 2.4mm BMT purlins in Region C, it is incorrect that spacing = original spacing x 150% x 126%. For multiple installation conditions change, please seek for the engineer's advice.

## APPENDIX B – ASSESSED PV RACKING FRAME PART DRAWINGS

**Note:**

This certification is a public access version, it does not include part drawings because of Goomax's intellectual properties. Refer to the full version of the certification for part drawings .