



**EBULEN CONSULT**

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

## **GOOMAX FLUSH-MOUNT SYSTEM WITH NON-PENETRATIVE CLAMPS**

Prepared for:

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

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Xiamen, China

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## OVERVIEW

This structural engineering certificate is issued for Goomax Roof Flush-mount racking system with Roof Clamp fixings, which has been 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 1170.1:2021 – 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 4312-2019 - Atmospheric corrosivity zones in Australia and detailed calculation referred to:
  - (1) ISO9224:2012 - Corrosion of metals and alloys Corrosivity of atmospheres - Guiding values for the corrosivity categories
  - (2) ISO9223:2012 - Corrosion of metals and alloys - Corrosivity of atmospheres - Classification, determination and estimation

## 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-R-69-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	AL6005-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 Clamp 1	GM-MRH-06-AZ	AL 6005-T5
Goomax Clamp 2	GM-MRH-07-AZ, GM-MRH-07L-AZ	AL 6005-T5
Goomax Clamp 3	GM-MRH-18-AZ	AL 6005-T5
Goomax Clamp 4	GM-MRH-19-AZ	AL 6005-T5
Goomax Clamp 5	GM-MRH-20-AZ	AL 6005-T5
Goomax Clamp 6	GM-MRH-T4-AZ	AL 6005-T5
Other Required but Non-structural Components	GM-E-EL-AZ, GM-EK-AZ, GM-SL-XJ-AZ, GM-XJ-AZ, GM-E-EL-12, GM-CT-AZ	SUS 304

**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 20m
- Maximum roof pitch is up to 30°
- Solar PV panel assessed: 2274mm x 1200mm, 2400mm x 1200mm, 2000mm 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
- The clamps capacities are taken from below testing reports:
  - No.20-0948 by Melbourne Testing Services (MTS) Pty Ltd, dated 15/10/2020
  - No.22-0561 by Melbourne Testing Services (MTS) Pty Ltd, dated 22/06/2020
- The clamps must mount over purlins
- The clamps have been assessed with the following roof sheeting types:
  - Lysaght KlipLok 700 Classic/Hi-strength
  - Lysaght KlipLok 406
  - Lysaght KlipLok 305

- Fielders Kingclip 700
- 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 aluminum material adopted for the solar racking frame system has been specified as AL6005-T5 by Goomax. The material used in the manufacturing process shall achieve the minimum strength requirements in AS/NZS 1664: 1997 – Aluminum Structures.***
- ***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.***
- ***This certification shall be reviewed and revalidated by the structural engineer in every two years from the date of issue or any updates of regulations or standards.***

## 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 AND FOOT SPACING TABLE 2M X 1M

**Interface Spacing Table for Terrain Category 3 (Unit: mm)**

Wind Region	Roof Height	H≤10m	10m<H≤15m	15m<H≤20m
A	Internal Zone	1800	1800	1196
	Intermediate Zone	1520	1152	767
	Edge Zone	1099	840	564
	Corner Zone	707	545	369
B	Internal Zone	1565	1185	788
	Intermediate Zone	992	760	512
	Edge Zone	726	559	379
	Corner Zone	473	366	249*
C	Internal Zone	980	751	506
	Intermediate Zone	633	488	332
	Edge Zone	467	362	247*
	Corner Zone	306	238*	163*
D	Internal Zone	620	479	325
	Intermediate Zone	405	314	214*
	Edge Zone	300	234*	160*
	Corner Zone	198*	154*	106*

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 2 (Unit: mm)**

Wind Region	Roof Height	H≤10m	10m<H≤15m	15m<H≤20m
A	Internal Zone	1579	1253	881
	Intermediate Zone	1000	802	570
	Edge Zone	732	590	422
	Corner Zone	476	385	277
B	Internal Zone	1029	824	586
	Intermediate Zone	663	535	383
	Edge Zone	489	396	284
	Corner Zone	321	260*	188*
C	Internal Zone	655	528	379
	Intermediate Zone	427	346	249*
	Edge Zone	317	257*	186*
	Corner Zone	209*	170*	123*
D	Internal Zone	419	339	244*
	Intermediate Zone	275	223*	161*
	Edge Zone	205*	167*	120*
	Corner Zone	136*	110*	80*

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.

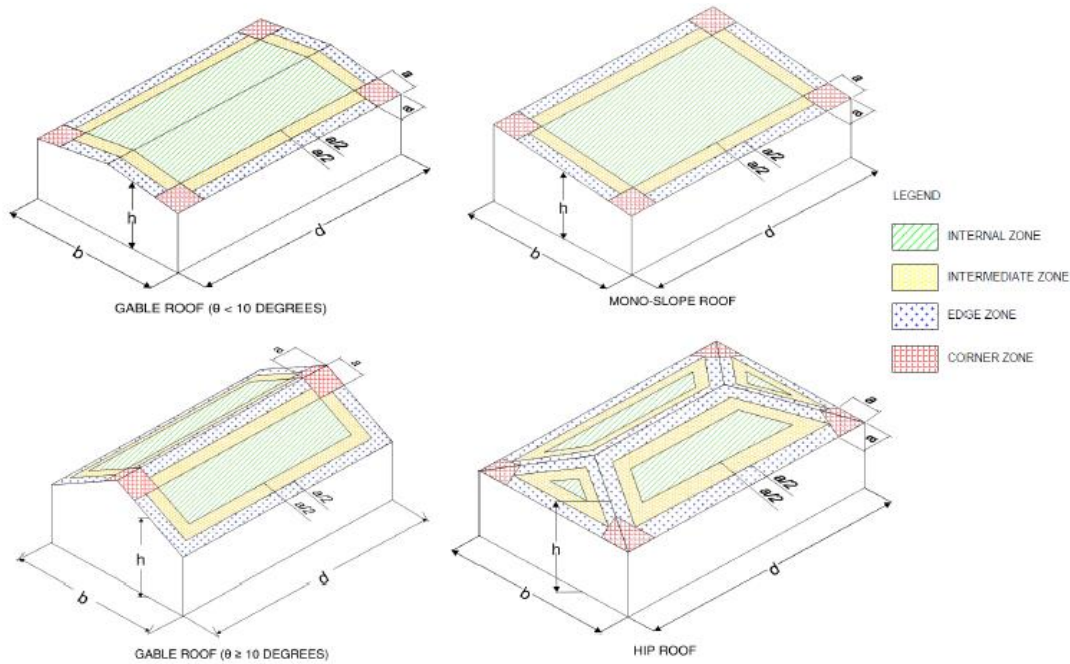
## General Notes

**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.

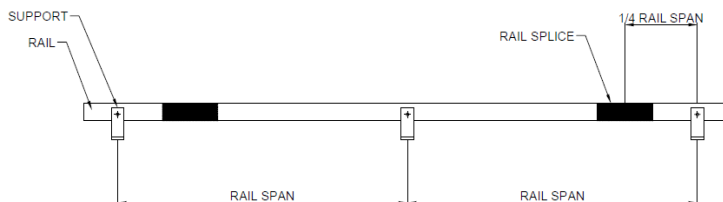


Refer to AS/NZS 1170.2:2021 – Chapter 5.4.4 for more accurate Roof Zone notion and cases.

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	4
	Corner	4	4	6	4	6	6
Region B	Internal	4	4	4	4	4	4
	Intermediate	4	4	4	4	4	6
	Edge	4	4	6	4	6	6
	Corner	4	6	NA	6	NA	NA
Region C	Internal	4	4	4	4	4	6
	Intermediate	4	4	6	4	6	NA
	Edge	4	6	NA	6	NA	NA
	Corner	6	NA	NA	NA	NA	NA
Region D	Internal	4	4	6	4	6	NA
	Intermediate	6	6	NA	6	NA	NA
	Edge	6	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** The clamps capacities are taken from testing report No.20-0948 and No.22-0561 by Melbourne Testing Services Pty Ltd, dated 15/10/2020 and 22/06/2022. Tests were carried out using the following roof sheeting products. Other roof sheeting products are not covered in this assessment. The clamps must mount over purlins.

GM-MRH-07/07L-AZ	Fielders KingKlip 700
GM-MRH-07/07L-AZ, GM-MRH-19-AZ, GM-MRH-20-AZ	Lysaght Kliplok 700
GM-MRH-06-AZ, GM-MRH-19-AZ, GM-MRH-20-AZ	Lysaght Kliplok 406
GM-MRH-18-AZ	Lysaght Longline 305
GM-MRH-T4-AZ	Lysaght Trimdek

**Note 8** According to the above-mentioned Testing Report No.20-0948, the GM-MRH-18-AZ clamp has been tested to a failure of slipping off from Lysaght Longline 305 sheeting. When install on Lysaght Longline 305 sheeting, apply a 65% reduction factor to the existing Spacing Tables to get final fixing spacing

**Note 9** 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.



## 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.