

July 30, 2014

Neil Erickson
Hawaii County Public Works – Building Division
Aupini Center, 101 Pauahi Street, Suite 7
Hilo, HI 96720

Re: Engineering Certification for the Mounting Systems, Inc. 13/52 Rail Span Chart

Dear Mr. Erickson,

This letter is to document that I have reviewed the Mounting Systems, Inc. 13/52 rail span chart and I have found that it is in compliance with the requirements for the wind and seismic design for Hawaii County. These requirements are acceptable up to a seismic design category E or less.

The effective wind pressure in Hawaii County is governed by a topographic factor, K_{zt} , a directionality factor, K_d , a wind exposure and a wind speed. The topographic factor, K_{zt} is assumed to be 1.0 for the most general case. The directionality factor, K_d is 0.85. The wind exposure category is B, C or D. Wind speed varies from 85 mph to 160 mph.

This Certification is for gable roof and hipped roof structures with height up to 30 feet and roof angle between 7 degree and 27 degree flush mount installations in 3 roof zones.

All systems where the panels are tilted up, and the systems that falls outside the above wind parameters, will require engineering by a licensed Hawaii Structural engineer.

Following are typical specifications for the connections to meet the Hawaii County requirements:

- Attachment Spacing: Mounting Systems, Inc. strongly recommends a maximum span of 8 feet, but in any case, not to exceed the maximum span indicated on the charts.
- Cantilever: Maximum cantilever length is $L/3$, where “L” is the span noted in the Span Chart Tables
- Clearance: 2” to 10” clear from top of roof to bottom of PV panel
- Roof Connection:
- Standing Seam Roof:
1. ASGU2AL clamp of Alpine SnowGuard with 3/8” stainless steel socket set screws.
 2. Corrugated Bracket of EcoFasten Solar with #12 x 1 1/2” roofing screws.

Composition Shingle Roof:

1. GreenFaste GF1 of EcoFasten Solar(UER-0216) with 5/16" lag bolt.

Tile Roof:

1. Tile Flashing System of EcoFasten Solar with 5/16" hex head lag screw.

Corrugated Metal Roof:

1. CorruSlide System of EcoFasten Solar with 1/4"-14x7/8" blazer Flange VRT screws.

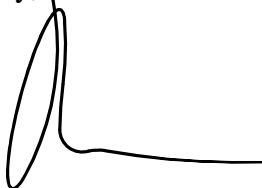
This letter is to certify the mounting structures and roof attachment to the existing structural members. The requirements of the overall structure need to be in compliance with the following codes:

1. Minimum Design Loads for Building and other Structures, ASCE/SEI 7-05
2. 2006 International Building Code, by International Code Council, Inc.
3. 2005 Aluminum Design Manual, by The Aluminum Association
4. AC428, Acceptance Criteria for Modular Framing Systems Used to support Photovoltaic (PV) Panels, November 1 2012 by ICC-ES
5. Guidelines for Permitting a Residential Photovoltaic (PV) Roof Mounted System, January 1 2013 by County of Hawaii

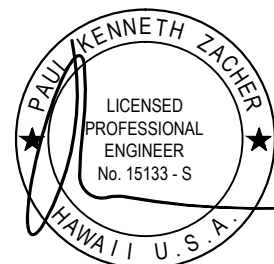
If the roof structure or any other structural component of the mounting structure do not meet with the requirement above, then the installation need to be analyzed and designed by a licensed Hawaii structural engineer.

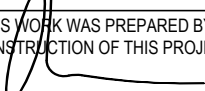
If you have any questions on the above, do not hesitate to call.

Sincerely,



Paul Zacher, SE - President



| | |
|---|--------------------------------|
| THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION AND CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION. | |
|  | 4/30/16 |
| Signature | Expiration Date of the License |

| 13/52 Rail Zone 1 Span Chart | | | | | | | | | | | |
|------------------------------|------------|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Exposure | Wind Speed | Ground Snow Load | | | | | | | | | |
| | | 0 psf | 10 psf | 20 psf | 30 psf | 40 psf | 50 psf | 60 psf | 70 psf | 80 psf | 90 psf |
| Category B | 85 | 10.0 | 8.5 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 100 | 10.0 | 8.5 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 110 | 9.5 | 8.5 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 120 | 9.0 | 8.5 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 130 | 8.0 | 8.0 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 140 | 7.5 | 7.5 | 6.5 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 150 | 7.0 | 7.0 | 6.5 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 160 | 7.0 | 7.0 | 6.5 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |

| Exposure | Wind Speed | Ground Snow Load | | | | | | | | | |
|------------|------------|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | 0 psf | 10 psf | 20 psf | 30 psf | 40 psf | 50 psf | 60 psf | 70 psf | 80 psf | 90 psf |
| Category C | 85 | 9.5 | 8.5 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 100 | 9.0 | 8.5 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 110 | 8.0 | 8.0 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 120 | 7.5 | 7.5 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 130 | 7.0 | 7.0 | 6.5 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 140 | 6.5 | 6.5 | 6.5 | 5.5 | 5.0 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 150 | 6.0 | 6.0 | 6.0 | 5.5 | 5.0 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 160 | 6.0 | 6.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |

| Exposure | Wind Speed | Ground Snow Load | | | | | | | | | |
|------------|------------|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | 0 psf | 10 psf | 20 psf | 30 psf | 40 psf | 50 psf | 60 psf | 70 psf | 80 psf | 90 psf |
| Category D | 85 | 9.0 | 8.5 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 100 | 8.5 | 8.0 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 110 | 7.5 | 7.5 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 120 | 7.0 | 7.0 | 6.5 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 130 | 6.5 | 6.5 | 6.5 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 140 | 6.0 | 6.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 150 | 5.5 | 5.5 | 5.5 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 160 | 5.5 | 5.5 | 5.5 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |

- a. The table above ONLY includes 13-52 rail capacity check. It does not include roof capacity check
- b. Wind Importance Factor =1.0 per ASCE 7-05
- c. Topographic factor, k_{zt} is 1.0
- d. Maximum mean roof height is 30 ft.
- e. Average parapet height is 0 ft
- f. Roof pitch is between 7 degree and 27 degree
- g. Maximum solar panel weight is 60 lbs
- h. Height of solar panel is between 2" and 10" to roof
- i. Deflection criteria of L/60 per AC428 Section 4.3
- j. The wind speeds above are ASD values
- k. Mounting Systems, Inc. strongly recommends a maximum span of 8 feet, but in any case, not to exceed the maximum span indicated on the chart
- l. The span length applies to a seismic design category E or less
- m. Maximum cantilever is L/3

| 13/52 Rail Zone 2 Span Chart | | | | | | | | | | | |
|------------------------------|------------|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Exposure | Wind Speed | Ground Snow Load | | | | | | | | | |
| | | 0 psf | 10 psf | 20 psf | 30 psf | 40 psf | 50 psf | 60 psf | 70 psf | 80 psf | 90 psf |
| Category B | 85 | 8.5 | 8.0 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 100 | 7.5 | 7.5 | 7.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 110 | 7.0 | 7.0 | 6.5 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 120 | 6.5 | 6.5 | 6.5 | 5.5 | 5.0 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 130 | 6.0 | 6.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 140 | 5.5 | 5.5 | 5.5 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 150 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 160 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |

| Exposure | Wind Speed | Ground Snow Load | | | | | | | | | |
|------------|------------|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | 0 psf | 10 psf | 20 psf | 30 psf | 40 psf | 50 psf | 60 psf | 70 psf | 80 psf | 90 psf |
| Category C | 85 | 7.5 | 7.5 | 6.5 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 100 | 6.5 | 6.5 | 6.5 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 110 | 6.0 | 6.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 120 | 5.5 | 5.5 | 5.5 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 130 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 140 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 150 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 160 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |

| Exposure | Wind Speed | Ground Snow Load | | | | | | | | | |
|------------|------------|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | 0 psf | 10 psf | 20 psf | 30 psf | 40 psf | 50 psf | 60 psf | 70 psf | 80 psf | 90 psf |
| Category D | 85 | 6.5 | 6.5 | 6.5 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 100 | 6.0 | 6.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 110 | 5.5 | 5.5 | 5.5 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 120 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 130 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 140 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 150 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.5 |
| | 160 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.5 |

- a. The table above ONLY includes 13-52 rail capacity check. It does not include roof capacity check
- b. Wind Importance Factor =1.0 per ASCE 7-05
- c. Topographic factor, kzt is 1.0
- d. Maximum mean roof height is 30 ft.
- e. Average parapet height is 0 ft
- f. Roof pitch is between 7 degree and 27 degree
- g. Maximum solar panel weight is 60 lbs
- h. Height of solar panel is between 2" and 10" to roof
- i. Deflection criteria of L/60 per AC428 Section 4.3
- j. The wind speeds above are ASD values
- k. Mounting Systems, Inc. strongly recommends a maximum span of 8 feet, but in any case, not to exceed the maximum span indicated on the chart
- l. The span length applies to a seismic design category E or less
- m. Maximum cantilever is L/3

| 13/52 Rail Zone 3 Span Chart | | | | | | | | | | | |
|------------------------------|------------|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| Exposure | Wind Speed | Ground Snow Load | | | | | | | | | |
| | | 0 psf | 10 psf | 20 psf | 30 psf | 40 psf | 50 psf | 60 psf | 70 psf | 80 psf | 90 psf |
| Category B | 85 | 6.5 | 6.5 | 6.5 | 6.0 | 5.5 | 5.0 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 100 | 6.0 | 6.0 | 6.0 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 110 | 5.5 | 5.5 | 5.5 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 120 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 130 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 140 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 150 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.5 |
| | 160 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.5 |

| Exposure | Wind Speed | Ground Snow Load | | | | | | | | | |
|------------|------------|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | 0 psf | 10 psf | 20 psf | 30 psf | 40 psf | 50 psf | 60 psf | 70 psf | 80 psf | 90 psf |
| Category C | 85 | 5.5 | 5.5 | 5.5 | 5.5 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 100 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 110 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 120 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 130 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.5 |
| | 140 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.5 |
| | 150 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| | 160 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |

| Exposure | Wind Speed | Ground Snow Load | | | | | | | | | |
|------------|------------|------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | | 0 psf | 10 psf | 20 psf | 30 psf | 40 psf | 50 psf | 60 psf | 70 psf | 80 psf | 90 psf |
| Category D | 85 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 100 | 5.0 | 5.0 | 5.0 | 5.0 | 5.0 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 110 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.5 | 4.0 | 4.0 | 3.5 |
| | 120 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.5 |
| | 130 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 4.0 | 3.5 |
| | 140 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| | 150 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 | 3.5 |
| | 160 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 | 3.0 |

- a. The table above ONLY includes 13-52 rail capacity check. It does not include roof capacity check
- b. Wind Importance Factor =1.0 per ASCE 7-05
- c. Topographic factor, k_{zt} is 1.0
- d. Maximum mean roof height is 30 ft.
- e. Average parapet height is 0 ft
- f. Roof pitch is between 7 degree and 27 degree
- g. Maximum solar panel weight is 60 lbs
- h. Height of solar panel is between 2" and 10" to roof
- i. Deflection criteria of L/60 per AC428 Section 4.3
- j. The wind speeds above are ASD values
- k. Mounting Systems, Inc. strongly recommends a maximum span of 8 feet, but in any case, not to exceed the maximum span indicated on the chart
- l. The span length applies to a seismic design category E or less
- m. Maximum cantilever is L/3

| 13/52 Rail LRFD Allowable Uplift Wind Force (plf) | | | | | | | | | | | | | | | |
|---|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|
| Rail Span (ft) | 70 | 80 | 90 | 100 | 110 | 130 | 150 | 170 | 200 | 240 | 300 | 380 | 480 | 650 | 900 |
| 3.0 | | | | | | | | | | | | | | | 13/52 Rail |
| 3.5 | | | | | | | | | | | | | | 13/52 Rail | |
| 4.0 | | | | | | | | | | | | | 13/52 Rail | | |
| 4.5 | | | | | | | | | | | | 13/52 Rail | | | |
| 5.0 | | | | | | | | | | | 13/52 Rail | | | | |
| 5.5 | | | | | | | | | | 13/52 Rail | | | | | |
| 6.0 | | | | | | | | | 13/52 Rail | | | | | | |
| 6.5 | | | | | | | | 13/52 Rail | | | | | | | |
| 7.0 | | | | | | | 13/52 Rail | | | | | | | | |
| 7.5 | | | | | | 13/52 Rail | | | | | | | | | |
| 8.0 | | | | | 13/52 Rail | | | | | | | | | | |
| 8.5 | | | | 13/52 Rail | | | | | | | | | | | |
| 9.0 | | | 13/52 Rail | | | | | | | | | | | | |
| 9.5 | | 13/52 Rail | | | | | | | | | | | | | |
| 10.0 | 13/52 Rail | | | | | | | | | | | | | | |

| 13/52 Rail Span (ft) | LRFD Allowable Uplift Force (lb) |
|----------------------|----------------------------------|
| 3.0 | 1764 |
| 3.5 | 1480 |
| 4.0 | 1243 |
| 4.5 | 1101 |
| 5.0 | 960 |
| 5.5 | 838 |
| 6.0 | 756 |
| 6.5 | 690 |
| 7.0 | 651 |
| 7.5 | 598 |
| 8.0 | 533 |
| 8.5 | 510 |
| 9.0 | 480 |
| 9.5 | 444 |
| 10.0 | 402 |