

June 5, 2023

EcoFasten

4141 West Van Buren St.

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Attn.: John Hudson, Senior Director of Engineering, EcoFasten

Re: EcoFasten *SimpleGrip*-SQ Roof Attachment Capacities

This letter provides details on the mechanical load test and certifies the structural capacity of the EcoFasten *SimpleGrip*-SQ for use with solar systems when attached to a roof deck or rafter. The EcoFasten *SimpleGrip*-SQ consists of two cold rolled steel sub-assemblies including cold-rolled steel internal plate components and connecting hardware. A 5/16" stainless steel carriage bolt is included in the center of the part for use to connect compatible EcoFasten brackets. The EcoFasten *SimpleGrip*-SQ base sub-assembly has four holes spread radially about its center. The *SimpleGrip*-SQ is secured to the roof through these holes using two (2) No. 15 structural wood screws for rafter attachment or four (4) No. 15 structural wood screws for deck sheathing attachment. Screws shall be installed in accordance with the EcoFasten *SimpleGrip*-SQ installation guide. The EcoFasten *SimpleGrip*-SQ, *simplified as SimpleGrip going forward*, details and component dimensions are shown in Appendix A.

The structural capacities of the *SimpleGrip* were determined from mechanical load testing along three respective load directions including uplift, compression, and lateral. The capacity ratings are based on structural load tests performed using a Universal Instron Test Unit according to ASTM D1761-20 "Standard Test Methods for Mechanical Fasteners in Wood and Wood Based Materials". The *SimpleGrip* was tested as installed into a rafter and a roof deck with a steel L-foot. For each rafter attached load test, a *SimpleGrip* was installed on a sample roof deck constructed from 7/16" OSB over 2x4 rafters as shown in Figure 1. For each deck attached load test, a *SimpleGrip* was installed on a sample roof deck constructed from 2x4 rafters and an OSB roof deck sheathing with the following thicknesses: 7/16", 15/32", or 19/32", as shown in Figure 1. Deck sheathing was installed onto the roof rafters using 0.131" x 2.5" nails. The nailing schedules applied for the various sheathing thicknesses are as follows: 7/16" and 15/32" sheathing used 6" edge and 12" field spacing, and 19/32" sheathing used 6" edge and 6" field spacing, following guidelines from the Florida Residential Building Code Table R803.2.3.1. The moisture content and the specific gravity of the rafters were measured per ASTM D2395-17 "Standard Test Methods for Density and Specific Gravity (Relative Gravity) of Wood and Wood-Based Materials". The recorded moisture content of the rafters among all sample roof decks was between 12% and 14% and the specific gravity was 0.42. The tested *SimpleGrip* was affixed to the roof deck structure via four or to the rafter via two 2" #15 wood screws per the requirements specified by the *EcoFasten SimpleGrip Installation Guide*.

The failure observed during uplift load testing on *SimpleGrip* when rafter attached was tensile rupture of the cold formed steel *SimpleGrip* base. The cold formed steel tension failure mode with a 2.0 safety factor per AISI S-100 2016 is applied to the uplift peak load achieved from the average of five (5) tests. The average peak failure load was 1040 lbs., which provides an **allowable uplift capacity of 520 lbs.**

The failure observed during uplift load testing on *SimpleGrip* when deck attached was a mixture of wood screw withdrawal from the OSB deck, nail withdrawal from the rafter, and OSB rupture for all tested roof sheathing thicknesses. The wood screw withdrawal failure with a worst-case safety factor of 3.0 per ASTM D7147 is applied to the uplift peak load achieved from the average of five (5) tests. For a 7/16" thick OSB deck the peak failure load was 585 lbs., which provides an **allowable uplift capacity of 195 lbs.** For a 19/32" thick OSB deck the peak failure load was 819 lbs., which provides an **allowable uplift capacity of 273 lbs.**

The failure observed during compression load testing on *SimpleGrip* when deck attached was crushing, due to bearing, of the OSB deck under the *SimpleGrip* for all tested roof sheathing thicknesses. For the deck bearing failure, a safety factor of 2.54 per NDS 2018 is applied to the peak load achieved from the average of eight (8) tests provided for the 7/16" and 19/32" thicknesses and the five (5) tests provided for the 15/32" thickness. For a 7/16" thick OSB deck the peak failure load was 582 lbs., which provides an **allowable compression capacity of 229 lbs.** For a 15/32" thick OSB deck the peak failure load was 627 lbs., which provides an **allowable compression capacity of 247 lbs.** For a 19/32" thick OSB deck the peak failure load was 764 lbs., which provides an **allowable compression capacity of 301 lbs.**

For the lateral load tests, the *SimpleGrip* was tested simulating the most eccentric available installed position using the EcoFasten L-foot. The critical failure mode for lateral load was observed to be aluminum rupture of the L-foot for testing of *SimpleGrip* when rafter attached. The average of the rupture loads from five (5) lateral load tests is 717 lbs. and with a safety factor of 1.95 applied to the aluminum rupture failure mode, **the allowable capacity for a lateral load is 368 lbs.** The lateral load test for *SimpleGrip* when deck attached was performed with the *SimpleGrip* installed on the worst-case roof deck using the minimum sheathing thickness of 7/16". The critical failure mode for lateral load was observed to be fastener withdrawal for testing on *SimpleGrip* when deck attached. The average of the wood screw withdrawal loads from eight (8) lateral load tests is 437 lbs. and with a safety factor of 3.0 applied to the fastener withdrawal failure mode, **the allowable capacity for a lateral load is 146 lbs.**

Please note the provided test investigation and its associated results described herein were based on the load tests performed on the *SimpleGrip* as a stand-alone roof attachment. It is not the intention of this letter to rate or certify the selected solar system level performance or structural components other than those specifically delineated in this letter. This evaluation excludes the structural adequacy of the chosen PV modules, or underlying roof supporting members. For those, it shall be the responsibility of the designated system designer or project engineer to verify the structural capacity and adequacy regarding the applied or resultant loads of the chosen array configuration.

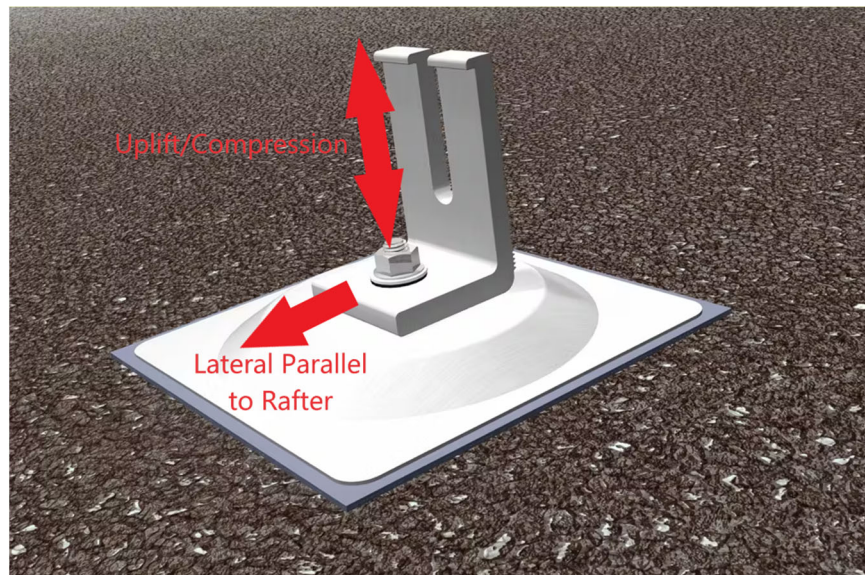


Figure 1: EcoFasten SimpleGrip-SQ with L-foot and Applied Loading Directions

Table 1: EcoFasten SimpleGrip-SQ Deck and Rafter Attachment Allowable Capacities ⁽¹⁾

Load Direction	Attachment Type	Minimum Sheathing Thickness (in) ⁽⁷⁾	Test Quantity	Critical Failure Mode	Safety Factor ⁽⁵⁾	Avg Ultimate Capacity (lbs.)	Max deviation from mean ⁽⁴⁾	Allowable Capacity (lbs) ⁽⁶⁾
Uplift ⁽²⁾	Rafter	N/A	5	Cold Formed Steel Tension Rupture	2.0	1040	5.7%	520
	Deck	7/16	8	Fastener Withdrawal	3.0	585	17.7%	195
		19/32	8	Fastener Withdrawal	3.0	819	17.6%	273
Compression ⁽³⁾	Rafter	-	-	-	-	-	-	-
	Deck	7/16	8	OSB Bearing	2.54	582	21.0%	229
		15/32	5	OSB Bearing	2.54	627	5.6%	247
		19/32	8	OSB Bearing	2.54	764	14.6%	301
Lateral ⁽⁸⁾	Rafter with L-foot	N/A	5	Aluminum Rupture	1.95	717	1.8%	368
	Rafter without L-foot ⁽⁹⁾	N/A	6	Cold Formed Steel Tension Rupture	2.0	986	6.1%	493
	Deck	7/16	8	Fastener Withdrawal	3.0	437	28.7%	146

Table 1 Notes:

- (1) Capacities apply to a minimum deck thickness of 7/16", 15/32", and 19/32" on rafters spaced no greater than 24" using #15 wood screws, with full thread penetration of roof deck installed per the EcoFasten SimpleGrip-SQ Installation Guide. Rafters and roof deck should be in sound structural conditions with no sign of rot, decay, previous installation, or pre-existing damages.
- (2) The uplift direction is upward perpendicular to the roof surface.
- (3) The compression direction is downward perpendicular to the roof surface.
- (4) Deviation reflects the variance of the highest or the lowest test value from the group mean for the respective load direction. For load directions where deviation was larger than 10% after 5 tests, 3 additional tests are added per ADM-2020 Appendix 1.
- (5) Safety Factor is associated with the respective failure mode recorded and determined per AISI S-100 2016, NDS 2018, and ASTM 7147-21.
- (6) Allowable capacity is equal to Average Peak Load at Failure divided by its associated Safety Factor.
- (7) Minimum Sheathing Thickness applicable for either OSB or Plywood deck construction.
- (8) Lateral Loads apply to all tested sheathing thicknesses using the compatible EcoFasten bracket listed.
- (9) Lateral Load must be converted based on the eccentricity created by the bracket used with SimpleGrip.

Sincerely,

Matthew S Kuzila, PE

APPENDIX A: ENGINEERING DRAWING

