EcoFasten™
An ESDEC Company

US Headquarters | 4141 W. Van Buren St., Ste. 2 | Phoenix, AZ 85009
US Branch | 976 Brady Ave., Ste. 100 | Atlanta, GA 30318

December 21th, 2022

EcoFasten

4141 West Van Buren St.

Phoenix, AZ 85009

Attn.: John Hudson, Senior Director Engineering, EcoFasten

Re: EcoFasten *ClickFit Smart Foot UltraGrip™* Deck Roof Attachment

This letter certifies the structural capacity of the *EcoFasten ClickFit Smart Foot UltraGrip™* for use with flush mount railed solar systems, when attached to a roof deck. The *EcoFasten ClickFit Smart Foot* consists of a cast aluminum base with a 2" long vertical open-end slot for connection of a railed system. The base of the *EcoFasten ClickFit Smart Foot* has 6 holes for roof attachment via No. 14 wood screws. An *UltraGrip™ Flashing Technology* system is affixed to the underside of the *Smart Foot* base. *Smart Foot* is secured to the roof deck sheathing using six (6) No. 14 x 3" structural wood screws. Screws shall be installed in accordance with the *EcoFasten ClickFit Smart Foot* installation manual. Full assembly details are shown in Appendix A.

The structural capacities of the *Smart Foot* are reviewed along four respective load directions including uplift, compression, lateral parallel to the rafter, and lateral perpendicular to the rafter for base orientations that represent rail running cross-slope or up slope in relation to roof pitch. 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"*. For each load test, a *Smart Foot* 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 is between 12% and 14% and the specific gravity was 0.42. The tested *Smart Foot* was affixed to the roof deck structure via 3" long #14 stainless steel structural wood screws per the requirements specified by the *EcoFasten ClickFit Installation Guide*. For each load test, the point load was placed at the highest position allowed in the open-end slot. The tested *Smart Foot* was installed with 4 screws to account for striped screws or screws installed in deck joints.

The failure observed during uplift load testing 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. For a 7/16" and 15/32" 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 compression load failure observed was rupture of the OSB deck under the *Smart Foot* for all tested roof sheathing thicknesses. For the deck rupture failure, a safety factor of 2.54 is applied per NDS 2018 to the peak load. 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 247lbs**. For a 19/32" thick OSB deck the peak failure load was 764lbs., which provides an **allowable compression capacity of 301 lbs**.

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For each lateral load direction, the *Smart Foot* was tested in the worst-case condition installed onto a roof deck with minimum sheathing thickness of 7/16" and with the load placed at the highest position allowed in the vertical slot. The lowest peak lateral load recorded from all tests including both lateral directions and base orientations was used to determine the allowable lateral capacity. The failure observed was fastener withdrawal from the OSB sheathing at the peak load of 352 lbs. For the fastener withdrawal failure, a safety factor of 3.0 per ASTM D7147 applied to the lateral peak load which provides an **allowable lateral capacity of 117 lbs.**

Please note the provided test investigation and its associated results described herein were based on the load tests performed on the *Smart Foot* as a stand-alone roof attachment. It is not the intention of this letter to rate or certify *ClickFit* 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.

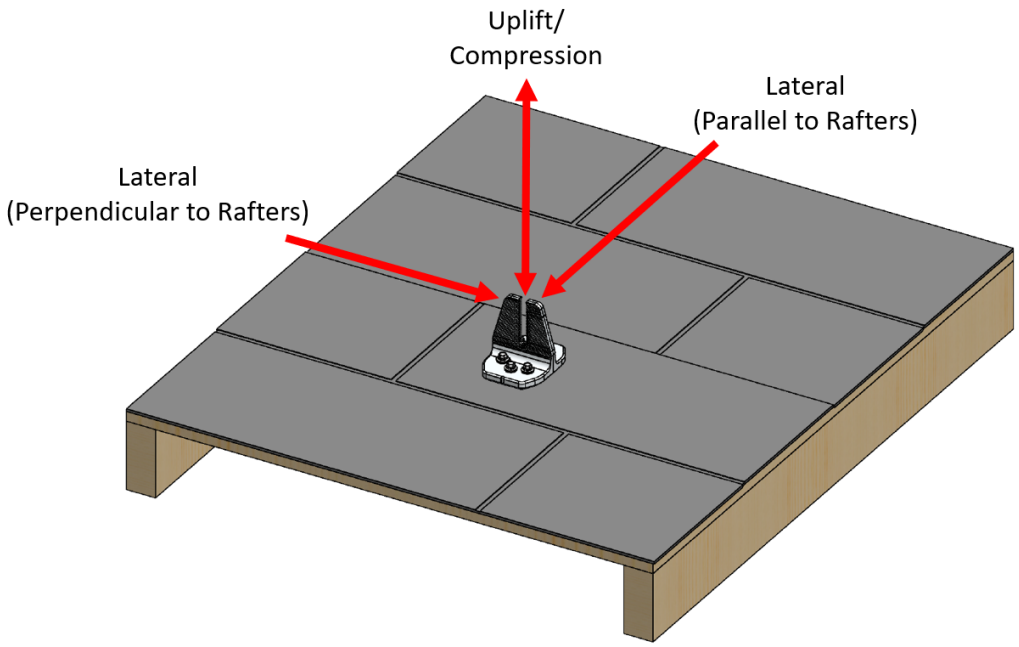

Figure 1: *EcoFasten* ClickFit Smart Foot and Applied Loading Directions

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Table 1: EcoFasten *ClickFit Smart Foot* Deck Attachment Allowable Capacities [1]							
Load Direction	**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]	7/16	8	Fastener Withdrawal	3.0	585	21.4%	195
	19/32	8	Fastener Withdrawal	3.0	819	17.6%	273
Compression [3]	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]	7/16	8	Fastener Withdrawal	3.0	352	14.3%	117

Table 1 Notes:

(1) Capacities apply to a minimum deck thickness of 7/16", 15/32", and 19/32" on rafters spaced at 24" using 3" long #14 wood screws installed per the EcoFasten *ClickFit 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 *NDS 2018,* and *ASTM 7147-21.*
(6) Allowable capacity is equal to Average Peak Load at Failure divided by its associated Safety Factor.
(7) Sheathing Thickness applicable for either OSB or Plywood deck construction.
(8) Allowable lateral capacities apply to sheathing that has a minimum thickness of 7/16" and is applicable to all lateral load directions and *Smart Foot* orientations.

Sincerely,

Matthew S Kuzila, PE

Structural Engineer

Digitally Signed 12/21/2022

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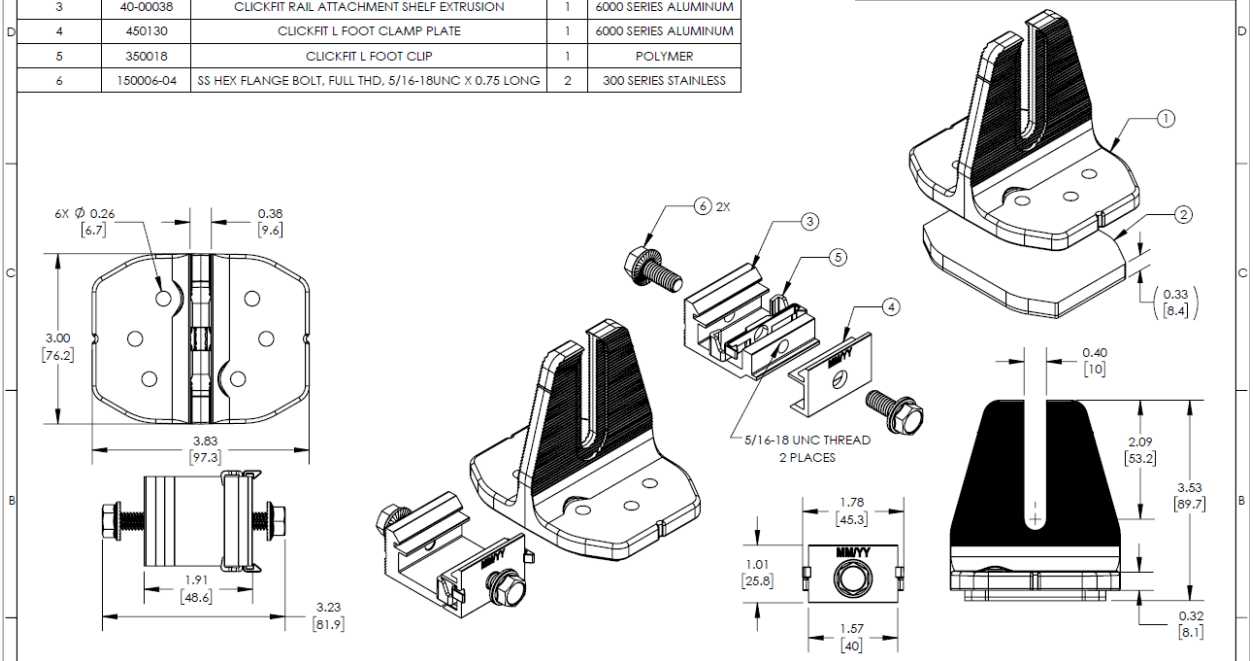
APPENDIX A: ENGINEERING DRAWING

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	MATERIAL
1	50-00006	INTEGRATED MOUNT CASTING	1	300 SERIES ALUMINUM
2	70-00091	FLASHING SYSTEM	1	SEE NOTES
3	40-00038	CLICKFIT RAIL ATTACHMENT SHELF EXTRUSION	1	6000 SERIES ALUMINUM
4	450130	CLICKFIT L FOOT CLAMP PLATE	1	6000 SERIES ALUMINUM
5	350018	CLICKFIT L FOOT CLIP	1	POLYMER
6	150006-04	SS HEX FLANGE BOLT, FULL THD, 5/16-18UNC X 0.75 LONG	2	300 SERIES STAINLESS

UL2

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
UL1	RELEASED	08/30/2022	RAD/JPS
UL2	REVISED DESCRIPTION: WAS " CF FLASHLESS MNT W/CLKR AL MLL" NOW "CF SMART FOOT W/CLKR AL MLL" UPDATED ITEM 2 DESCRIPTION. UPDATED NOTE2. (ECO#EP2215)	10/11/2022	RAD/JPS



UL2

UNLESS OTHERWISE SPECIFIED:
1. ITEM1: MILL FINISH OR BLACK FINISH
2. ITEM 2: FLASHING SYSTEM: PRESSURE SENSITIVE ADHESIVE (OR ESDEC APPROVED EQUIVALENT).
EPDM FOAM PAD (OR ESDEC APPROVED EQUIVALENT) AND ETERNABOND SEALANT (OR ESDEC APPROVED EQUIVALENT).

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THIRD ANGLE PROJECTION

DO NOT SCALE DRAWING

PROPRIETARY AND CONFIDENTIAL

DRAWN	RAD	04/22/2022
ENG APPR.	JH	08/30/2022

INTERPRET DIM AND TOLERANCE PER ASME Y14.5[M]-2009

DIMENSIONS TOLERANCES ARE IN:

INCHES	MILLIMETERS
.XX: +/- .050	.X: +/- 1.3
.XXX: +/- .050	.XX: +/- 1.3

ANGLES: +/- 5°

DESCRIPTION: CF SMART FOOT W/CLKR (UL)

SIZE A | DWG. NO. 2012028 (UL) | REV. UL2

SCALE:1:2 | SHEET 1 OF 1

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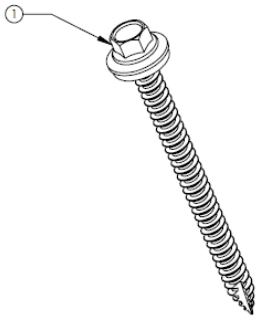
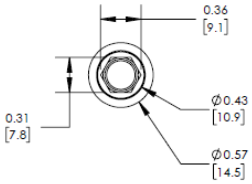
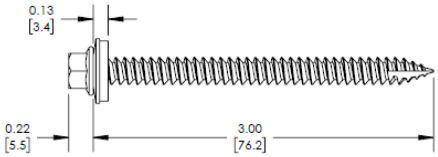
ITEM NO.	PART NUMBER	DESCRIPTION	QTY.	MATERIAL
1	70-00097	SELF DRILLING SCREW, #14, WOOD TIP, WITH A SEALING WASHER ASSEMBLY	1	300 SERIES STAINLESS STEEL AND EPDM

REVISIONS			
REV.	DESCRIPTION	DATE	APPROVED
UL 1	RELEASED	10/21/2022	KL/JPS







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DRAWN	KL	07/20/2022
ENG APPR.	DFM	10/21/2022

INTERPRET DIM AND TOLERANCE PER ASME Y14.5[M]-2009

DIMENSIONS TOLERANCES ARE IN:

INCHES	MILLIMETERS
.XX: +/- .050	.X: +/- 1.3
.XXX: +/- .050	.XX: +/- 1.3

ANGLES: +/- 5°

DESCRIPTION: SCREW #14X3" W/BW (UL)

SIZE: A | DWG. NO.: 3016018 (UL) | REV.: UL 1

SCALE:1:1 | SHEET 1 OF 1