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

March 13, 2023

EcoFasten

4141 West Van Buren St.

Phoenix, AZ 85009

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

Re: EcoFasten *QuickFoot* Roof Attachment Capacities

This letter provides details on the mechanical load test and certifies the structural capacity of the EcoFasten *QuickFoot* for use as a roof attachment for flush mount railed solar systems. *QuickFoot* consists of an extruded aluminum base, an aluminum flashing and a 3/8" steel stud used to connect compatible EcoFasten brackets to *QuickFoot*. *QuickFoot* is secured to the roof deck through a pair of holes in the base via #15 wood screws. Full assembly details and component dimensions are shown in Exhibit A.

The structural capacities of the EcoFasten *QuickFoot* are reviewed along two respective load directions: uplift and lateral. The stated capacities in this letter apply to *QuickFoot* and the listed mounting brackets with no consideration of the roof deck substructure. The capacities are based on mechanical load testing using a Universal Instron Test Unit. This certification conforms to the structural requirements of the following reference documents:

1. 2015/2018 International Building Code, by International Code Council, Inc
2. Aluminum Design Manual 2020, by the Aluminum Association, Inc.
3. ASTM B 557-15, Standard Test Method for Tension Testing Wrought and Cast Aluminum and Magnesium-Alloy Products
4. ASTM A370-21, Standard Test Methods and Definitions for Mechanical Testing of Steel Products

Tables 1 and 2 summarizes the test results and allowable capacities of the *QuickFoot* Assembly along each rated load direction. Please note the test investigation and its results described herein were based on the load tests performed on the *QuickFoot* as a stand-alone roof attachment. This evaluation excludes the structural adequacy of the underlying roof supporting members. Consideration was given to the capacities of the listed components and their approved method of installation.

Uplift testing was performed with the QuickFoot attached to a steel bench to ascertain the ultimate uplift capacity of the QuickFoot extruded base independent of wood screw length. The failure observed during uplift load testing was aluminum rupture along the attachment stud. The average of the uplift peak load from eight (8) uplift load tests is 3450 lb and with a safety factor of 1.95 for aluminum rupture per ADM 2020 applied to this failure mode, **the allowable uplift capacity is 1769 lbs**. It should be noted that the anchorage of the part is likely to control the design in normal use, which is reflected in the tables below.

For the lateral load tests, the *QuickFoot* was tested using a 3" steel L-foot, to ascertain the ultimate capacity of the QuickFoot and #15 wood screws in lateral load independent of any attached brackets. The lateral load test was performed with the *QuickFoot* installed on a sample roof deck constructed from 2x4 rafters and 7/16" OSB roof deck sheathing, with #15 wood screws. 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. Testing was performed with the point load placed at the highest allowable position in the L-Foot. The critical failure mode for lateral load was observed to be aluminum rupture of the *QuickFoot* along the attachment stud. The

average of the peak loads from five (5) lateral load tests is 934 lbs. and with a safety factor of 1.95 applied to the aluminum rupture failure mode, **the allowable capacity for a lateral load is 479 lbs**. It should be noted that when QuickFoot is used with a compatible EcoFasten L-foot the lateral capacity is limited by the EcoFasten L-foot selected, and so the lateral capacity for QuickFoot with various products is listed in the table below.

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

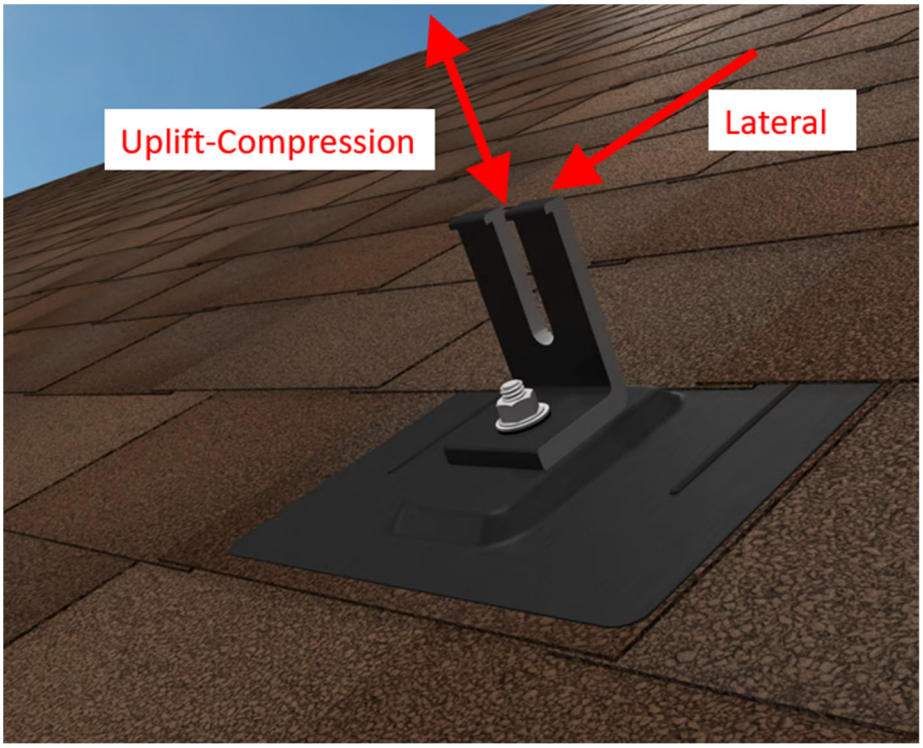

Figure 1: *EcoFasten* QuickFoot and Applied Loading Directions

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Table 1: EcoFasten *QuickFoot* Allowable Capacities [1]						
Load Direction	**Test Quantity**	**Critical Failure Mode**	**Safety Factor [5]**	**Avg Ultimate Capacity (lbs.)**	**Max deviation from mean [4]**	**Allowable Capacity (lbs) [6]**
QuickFoot Uplift [2][7]	8	Aluminum Rupture	1.95	3450	15%	1769
Lateral QuickFoot with 3" L-Foot [3]	5	Aluminum Rupture	1.95	717	1.80%	368
Lateral QuickFoot with ClickFit L-Foot [3]	5	Aluminum Rupture	1.95	571	2.33%	293

Table 2: Wood Screw Uplift Capacities (per pair)		
Screw Diameter	**Threaded Length**	**Allowable Capacity (lbs) [8]**
#15	2”	523
	3”	941
	4”	1359

Table Notes:

(1) Capacities apply to the EcoFasten QuickFoot used with listed compatible EcoFasten brackets per the installation manual.
(2) The Uplift direction is upward perpendicular to the roof surface.
(3) The allowable lateral capacity is applicable to the relevant L-foot in both parallel and perpendicular orientation with respect to the rafter.
(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 by the specific code reference document as listed on Page 1.
(6) Allowable capacity is equal to Average Peak Load at Failure divided by its associated Safety Factor.
(7) Allowable uplift capacity of part/assembly may exceed the withdrawal capacity of the wood screws used. Capacities for wood screw options using two screws of the same threaded length were calculated per NDS and are provided in Table 2. Uplift capacity selected shall be lower of Wood Screw Uplift capacity and QuickFoot Uplift capacity.
(8) Allowable capacities were calculated per National Design Specification (NDS-2018) Eq. (12.2-2) using a rafter specific gravity of 0.42 assuming a sheathing thickness of 7/16in. For rafters with a different specific gravity, the allowable uplift capacity shall be adjusted using a factor of $(G/0.42)^2$. Rafters and roof deck should be in sound structural conditions with no sign of rot, decay, previous installation, or pre-existing damages.

Sincerely,

Matthew S Kuzila, PE

Digitally Signed 3.13.2023

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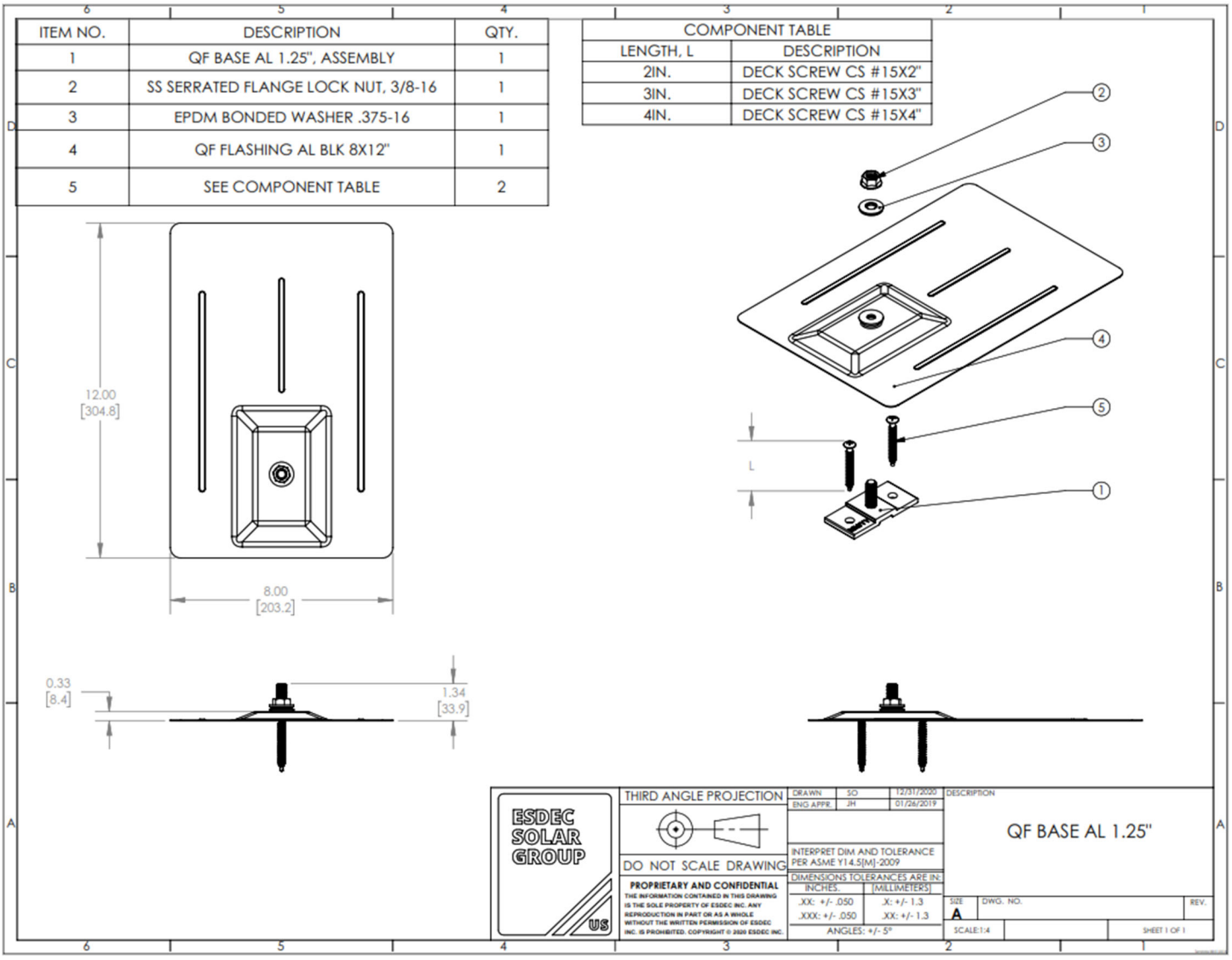
APPENDIX A: ENGINEERING DRAWING

ITEM NO.	DESCRIPTION	QTY.
1	QF BASE AL 1.25", ASSEMBLY	1
2	SS SERRATED FLANGE LOCK NUT, 3/8-16	1
3	EPDM BONDED WASHER .375-16	1
4	QF FLASHING AL BLK 8X12"	1
5	SEE COMPONENT TABLE	2

COMPONENT TABLE	
LENGTH, L	DESCRIPTION
2IN.	DECK SCREW CS #15X2"
3IN.	DECK SCREW CS #15X3"
4IN.	DECK SCREW CS #15X4"



ESDEC SOLAR GROUP US

THIRD ANGLE PROJECTION

DO NOT SCALE DRAWING

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DRAWN	SO	12/31/2020
ENG APPR.	JH	01/26/2019

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: QF BASE AL 1.25"

SIZE A | DWG. NO. | REV.

SCALE:1:4 | SHEET 1 OF 1