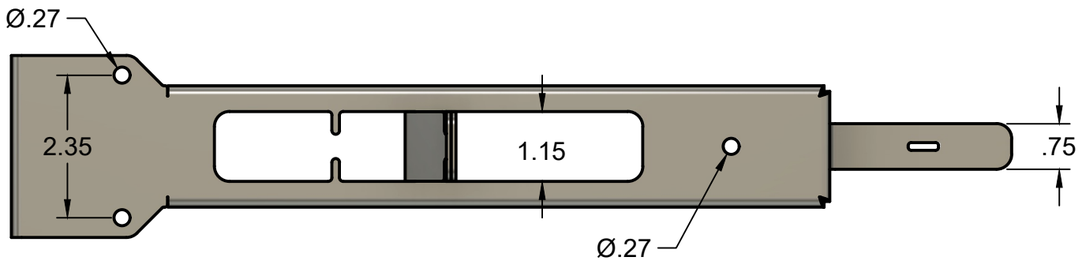
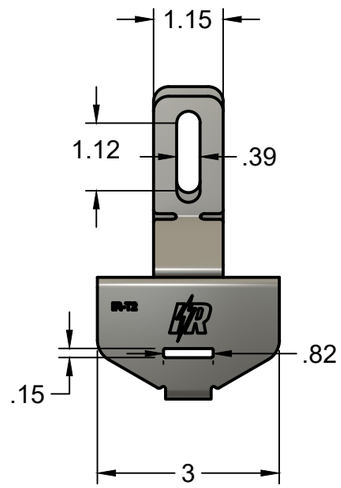
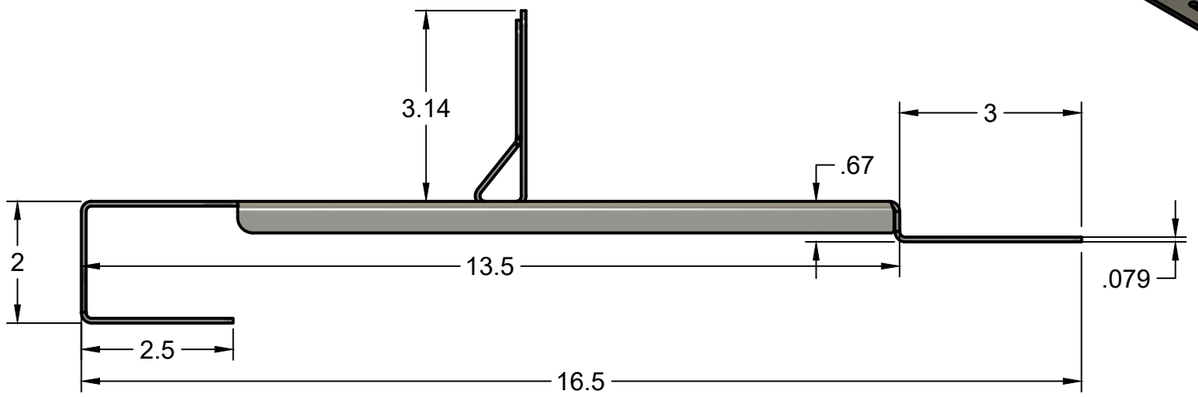


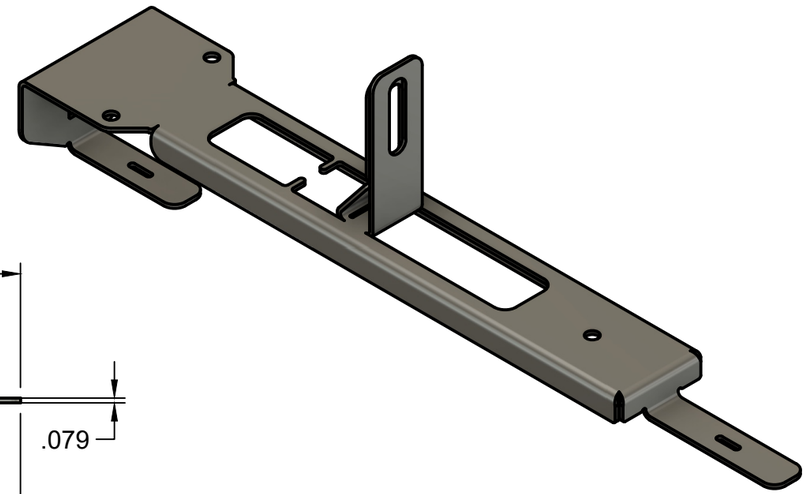
Top View



Back View



Side View



APPROVED	Paul Budge	08/02/2024	SIZE	CODE	DWG NO	REV
CHECKED	Paul Budge	08/02/2024	B			
DRAWN	Jeff Glauser	08/01/2024	SCALE 1:2.5	WEIGHT 1lb 3oz	SHEET 1/1	

PROJECT

IntegraRack

TITLE

IR-T1 No Penetration TileBallast™ Solar Module Mounting System

IR-T1TB1031

Maximum Solar Module Size		
24 SQFT		
IR-T1 Spacing For Rails	**Maximum Wind Speed**	**Maximum Snow Load**
One Mount Every 6 ft	120 MPH	10 LBS/SQFT
One Mount Every 4 ft	160 MPH	15 LBS/SQFT

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March 7, 2024
Mr. Paul Budge
Diversi-Tech Corp - IntegraRack
PO Box 910758
St. George, UT 84791

Subject: Compression, Horizontal, and Uplift Load Testing on the Universal L Foot Bracket (PN IR-DMLF2000) & IR-T1 No Penetration Tile Roof Bracket (IR-FCTR1500)

Dear Mr. Budge,

Please find included our test reports for the compression load test, horizontal load test, and combined uplift load testing of the Universal L Foot Bracket (PN IR-DMLF2000) & IR-T1 No Penetration Tile Roof Bracket (IR-FCTR1500) performed at our laboratory at 941 S. Park Lane, Tempe, AZ on 10/04/2023. The solar panels were installed on the tile roof using a total of 4 brackets

The compression load test was performed using dead weight provided by water filled plastic jugs that were weighed on our Instron 5985 test machine and had an average weight of 45.31 lbf. Test loads up to 815.58 lbf, equivalent to 38.00 psf force applied to the solar panels, were applied by evenly distributing the dead weight on the solar panel. Brackets were inspected before, during, and after the load test. Under load the brackets deflected downwards towards the roof but did not come into contact with the tile. Once the weight was removed the brackets were inspected and found to have lifted back to their original position and no visual permanent damage was noted. Test run details are shown in the table below.

COMPRESSION TEST LOAD INFORMATION			
TEST LOAD 1:	11 Jugs = 498.41 lbf = 23.22 psf	**TEST LOAD 2:**	17 Jugs = 770.27 lbf = 35.88 psf
TEST LOAD 3:	18 Jugs = 815.58 lbf = 38.00 psf		

COMPRESSION TEST LOAD BRACKET AND PANEL VISUAL DEFLECTION OBSERVATIONS			
NO.	**NO LOAD - INITIAL VISUAL BRACKET SPACING**	**AT LOAD 1 (498.41 lbf) VISUAL BRACKET SPACING**	**AT LOAD 2 (770.27 lbf) VISUAL BRACKET SPACING**
1	No contact	No contact	No contact
2	No contact	No contact	No contact
3	No contact	No contact	No contact
4	No contact	No contact	No contact

The horizontal load test was conducted using a Weightronic Digital Dynamometer (Model OCS-Y) and chain hoist. A horizontal load of at least 500 lbf was applied at the center of the crossbeam that was attached to the panel brackets. The test specimen held the load and no damage or permanent deformation was noted as shown in the test observations table shown below.

HORIZONTAL LOAD TEST TO > 500 lbf - VISUAL TEST OBSERVATIONS						
	INITIAL		UNDER TEST LOAD (500 lbf)		AFTER LOAD REMOVAL	
NO.	BRACKET DEFORMATION	PANEL DEFORMATION	BRACKET DEFORMATION	PANEL DEFORMATION	BRACKET DEFORMATION	PANEL DEFORMATION
1	None	None	Moderate	Moderate	None	None
2	None	None	Moderate	Moderate	None	None
3	None	None	Moderate	Moderate	None	None
4	None	None	Moderate	Moderate	None	None

The uplift load test was conducted using a Weightronic Digital Dynamometer (Model OCS-Y) and chain hoist. An uplift load of 710 lbf, equivalent to a 33.08 psf uplift force evenly applied to the solar panels, was applied at the center of the crossbeam that was attached to the four panel brackets. The test specimen held the load and no damage or permanent deformation of the test brackets was noted as shown in the test observations table shown below.

UPLIFT TENSILE LOAD TO 710 lbf - VISUAL TEST OBSERVATIONS						
	INITIAL		UNDER UPLIFT TEST LOAD (710 lbf)		AFTER LOAD REMOVAL	
NO.	BRACKET DEFORMATION	PANEL DEFORMATION	BRACKET DEFORMATION	PANEL DEFORMATION	BRACKET DEFORMATION	PANEL DEFORMATION
1	None	None	Moderate	Moderate	None	None
2	None	None	Moderate	Moderate	None	None
3	None	None	Moderate	Severe	None	None
4	None	None	Moderate	Moderate	None	None

Test reports with additional details, photos, and sketches of the test setup and load points have been attached.

Respectfully submitted,
PHOENIX NATIONAL LABORATORIES, INC.

Kyle Fleege, P.E.
Project Manager / Mechanical Engineer
Phoenix National Laboratories
Ph: 1.602.431.8887
kyle@pnltest.com
www.pnltest.com

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941 S. Park Lane, Tempe, AZ 85281
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LABORATORY TEST REPORT

Compression Load Test
Ceramic Tile Roof

CLIENT	CLIENT PROJECT REF. NO.	CLIENT ORDER NO.
Diversi-Tech Corporation	Bracket Test - Vertical Load	per S.A.

MATERIAL SUBMITTED BY	PNL PROJECT NO.	S.O. NO.	PNL LAB NO.	TEST DATE	REPORT DATE
Client	26-231261	001	ML845913	10/04/2023	10/13/2023

SAMPLE DESCRIPTION	TECHNICIANS
Tile roof w/ Universal L Foot Bracket & IR-T1 No Penetration Tile Roof Bracket	TR, MC, DG

TEST DATA & EQUIPMENT INFORMATION

TEMPERATURE:	88 °F ± 3 °F	**HUMIDITY:**	15%
TEST SPECIMEN SIZE:	Tile roof: 39.375 in. x 78.500 in.	**TEST SPECIMEN AREA:**	21.465 ft^2
COMPRESSION TYPE:	Fixed weight; applied with Water Jugs	**AVERAGE FORCE PER JUG:**	45.31 lbf
BRACKET COMPONENT 1:	Universal L Foot Bracket	**BRACKET PART NO. 1:**	IR-DMLF2000
BRACKET COMPONENT 2:	IR-T1 No Penetration Tile Roof Bracket	**BRACKET PART NO. 2:**	IR-FCTR1500

COMPRESSION TEST LOAD INFORMATION

TEST LOAD 1:	11 Jugs = 498.41 lbf = 23.22 psf	**TEST LOAD 2:**	17 Jugs = 770.27 lbf = 35.88 psf
TEST LOAD 3:	18 Jugs = 815.58 lbf = 38.00 psf		

BRACKET AND PANEL VISUAL DEFLECTION OBSERVATIONS

NO.	NO LOAD - INITIAL VISUAL BRACKET SPACING	AT LOAD 1 - VISUAL BRACKET SPACING	AT LOAD 2 - BRACKET SPACING	AT LOAD 3 - VISUAL SPACING
1	No contact	No contact	No contact	No contact
2	No contact	No contact	No contact	No contact
3	No contact	No contact	No contact	No contact
4	No contact	No contact	No contact	No contact

REMARKS:

TECHNICIAN_____ REVIEWED BY_____

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LABORATORY TEST REPORT

Compression Load Test
Ceramic Tile Roof

CLIENT	CLIENT PROJECT REF. NO.	CLIENT ORDER NO.
Diversi-Tech Corporation	Bracket Test - Vertical Load	per S.A.

MATERIAL SUBMITTED BY	PNL PROJECT NO.	S.O. NO.	PNL LAB NO.	TEST DATE	REPORT DATE
Client	26-231261	001	ML845913	10/04/2023	10/13/2023

SAMPLE DESCRIPTION	TECHNICIANS
Tile roof w/ Universal L Foot Bracket & IR-T1 No Penetration Tile Roof Bracket	TR, MC, DG

TEST PROCEDURE/DESCRIPTION

The test specimen consisted of the solar panels, brackets, railing and the simulation tile roof. The bracket locations were visually examined for gap spacing to ensure there was no contact between the roof tile and the bracket. At each location a sheet of paper was slid beneath the bracket to verify open spacing between the tile and bottom of the bracket. After the initial inspection the compressive load was applied using plastic jugs filled with water. Four jugs were randomly selected and weighted to determine an average weight per jug of 45.31 lbf. Load was applied evenly by even distribtuion of 11 water jugs across the test specimen. After the first load was applied, the gaps between the brackets and tile roof were examined. Additional load was applied with 17 jugs and then 18 jugs. At 18 jugs the gap between the bracket and the roof was too tight to fit the sheet of paper underneath due to geometry of the tile roof but the bracket was not in contact with the roof. After the final load test, all the weights were removed and the test specimen was visually examined for any permanent damage or deforamtion.

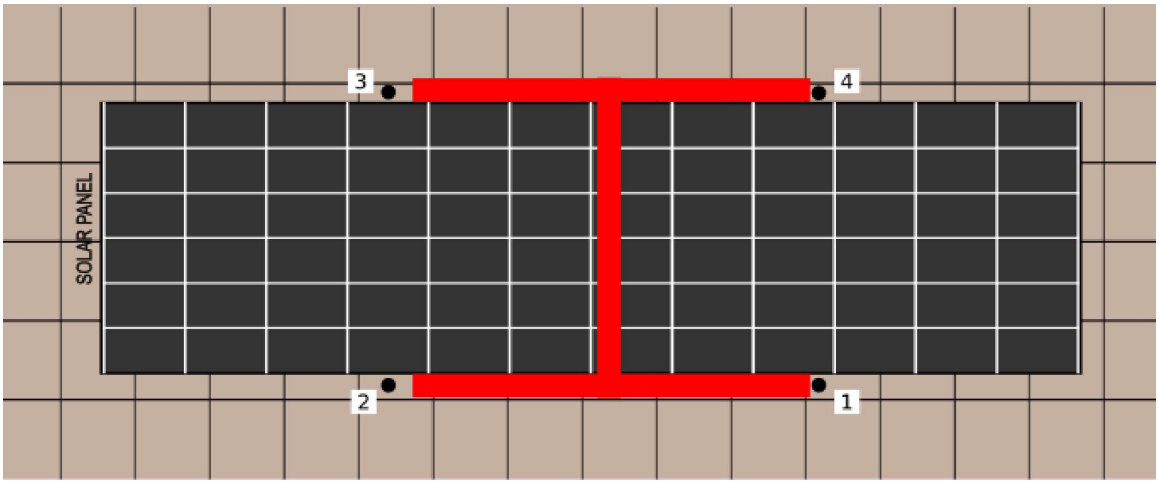
DEAD WEIGHT & DEFLECTION MEASUREMENT EQUIPMENT INFORMATION

EQUIPMENT MODEL:	Instron 5985 UTM [SN 1246]	**CALIBRATION DATE:**	07/25/2023
LOAD CELL:	2 kN (449.6 lbf) [SN 138082]	**CALIBRATION DATE:**	07/25/2023
EQUIPMENT MODEL:	Mitutoyo Digital Caliper [SN 14199376]	**CALIBRATION DATE:**	10/04/2023

DEAD WEIGHT MEASUREMENTS

NO. 1 (lbf)	NO. 2 (lbf)	NO. 3 (lbf)	NO. 4 (lbf)	AVERAGE (lbf)
45.45	45.65	44.69	45.46	45.31

VISUAL DEFORMATION LOCATION SKETCH



● Bracket/Panel Gap Spacing Check

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LABORATORY TEST REPORT

Compression Load Test
Tile Roof

CLIENT		CLIENT PROJECT REF. NO.		CLIENT ORDER NO.	
Diversi-Tech Corporation		Bracket Test - Vertical Load		per S.A.	
MATERIAL SUBMITTED BY	PNL PROJECT NO.	S.O. NO.	PNL LAB NO.	TEST DATE	REPORT DATE
Client	26-231261	001	ML845912	10/04/2023	10/13/2023
SAMPLE DESCRIPTION					TECHNICIANS
Tile roof w/ Universal L Foot Bracket & IR-T1 No Penetration Tile Roof Bracket					TR, MC, DG

PHOTOS

PHOTO 1: Overview of solar panel and tile roof deck - before tests

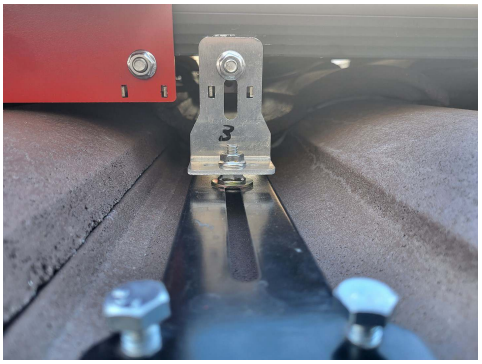

PHOTO 2: Typical Bracket - before tests

PHOTO 3: Load 1

PHOTO 4: Load 1 - Bracket under load

PHOTO 5: Load 2

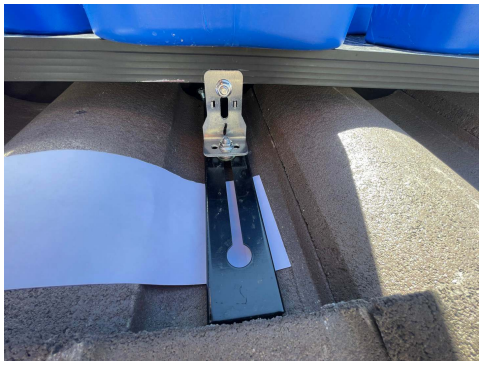

PHOTO 6: Load 2 - Bracket under load

PHOTO 7: Unloaded - after tests

PHOTO 8: Unloaded - after tests

PHOTO 9: Unloaded Bracket - after tests

Note: Bracket photos are typical of all locations

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LABORATORY TEST REPORT

Horizontal Load Test
Ceramic Tile Roof

CLIENT	CLIENT PROJECT REF. NO.	CLIENT ORDER NO.
Diversi-Tech Corporation	Bracket Test - Horizontal Load	per S.A.

MATERIAL SUBMITTED BY	PNL PROJECT NO.	S.O. NO.	PNL LAB NO.	TEST DATE	REPORT DATE
Client	26-231261	001	ML845913	10/04/2023	10/13/2023

SAMPLE DESCRIPTION	TECHNICIANS
Tile roof w/ Universal L Foot Bracket & IR-T1 No Penetration Tile Roof Bracket	TR, MC, DG

TEST PROCEDURE/DESCRIPTION

The test specimen consisted of the solar panels, brackets, railings and the simulation roof. The test specimen was initially visually examined for any damage or permanent deformation prior to testing. The horizontal load was applied after initial inspection was completed. The horizontal load was applied using a chain hoist and a digital dynamometer. The load was applied at the center of the crossbeam. The crossbeam was attached to the solar panel brackets. After the load was applied the specimen was examined for any damages or deformation while under load. After examination the horizontal load was released and the test specimen was examined again for any permanent deformation or damage.

TEST DATA & EQUIPMENT INFORMATION

TEMPERATURE:	88 °F ± 3 °F	**HUMIDITY:**	15% ± 5%
TEST SPECIMEN SIZE:	Tile roof: 39.375 in. x 78.500 in.	**TEST SPECIMEN AREA:**	21.465 ft^2
LOAD TYPE:	Tensile/Pull, applied with chain hoist	**TEST LOAD:**	>500 lbf
EQUIPMENT TYPE:	Weightronic Dynamometer	**EQUIPMENT MODEL:**	OCS-Y / 3000 kg Max.
BRACKET COMPONENT 1:	Universal L Foot Bracket	**BRACKET PART NO. 1:**	IR-DMLF2000
BRACKET COMPONENT 2:	IR-T1 No Penetration Tile Roof Bracket	**BRACKET PART NO. 2:**	IR-FCTR1500

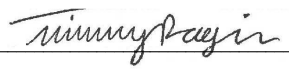
VISUAL TEST OBSERVATIONS

	INITIAL		UNDER TEST LOAD (500 lbf)		AFTER LOAD REMOVAL	
NO.	**BRACKET DEFORMATION**	**PANEL DEFORMATION**	**BRACKET DEFORMATION**	**PANEL DEFORMATION**	**BRACKET DEFORMATION**	**PANEL DEFORMATION**
1	None	None	Moderate	Moderate	None	None
2	None	None	Moderate	Moderate	None	None
3	None	None	Moderate	Moderate	None	None
4	None	None	Moderate	Moderate	None	None

OBSERVATIONS

After removal of test load all brackets returned to original position with no permanent deformation noted.

The solar panel did not show any signs of permanent damage or deformation.

TECHNICIAN 

REVIEWED BY 

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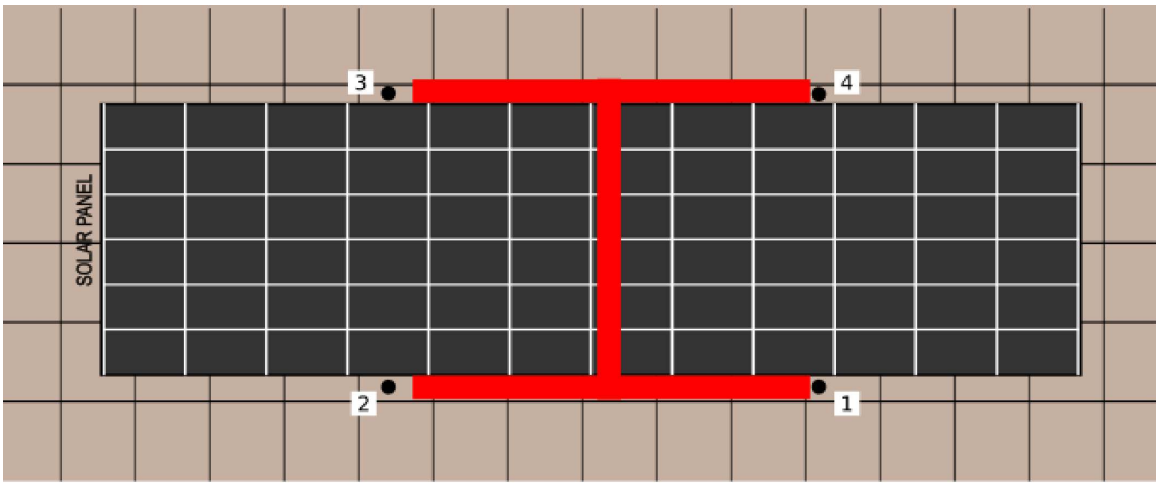
LABORATORY TEST REPORT

Horizontal Load Test
Ceramic Tile Roof

CLIENT		CLIENT PROJECT REF. NO.		CLIENT ORDER NO.	
Diversi-Tech Corporation		Bracket Test - Horizontal Load		per S.A.	
MATERIAL SUBMITTED BY	PNL PROJECT NO.	S.O. NO.	PNL LAB NO.	TEST DATE	REPORT DATE
Client	26-231261	001	ML845913	10/04/2023	10/13/2023
SAMPLE DESCRIPTION					TECHNICIANS
Tile roof w/ Universal L Foot Bracket & IR-T1 No Penetration Tile Roof Bracket					TR, MC, DG

SKETCH



● Bracket/Panel Gap Spacing Check

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LABORATORY TEST REPORT

Horizontal Load Test
Ceramic Tile Roof

CLIENT		CLIENT PROJECT REF. NO.		CLIENT ORDER NO.	
Diversi-Tech Corporation		Bracket Test - Horizontal Load		per S.A.	
MATERIAL SUBMITTED BY	PNL PROJECT NO.	S.O. NO.	PNL LAB NO.	TEST DATE	REPORT DATE
Client	26-231261	001	ML845913	10/04/2023	10/13/2023
SAMPLE DESCRIPTION					TECHNICIANS
Tile roof w/ Universal L Foot Bracket & IR-T1 No Penetration Tile Roof Bracket					TR, MC, DG

PHOTOS

PHOTO 1: Overview of solar panel and tile roof deck - before tests

PHOTO 2: Bracket with no load

PHOTO 3: Test setup for horizontal pull load

PHOTO 4: Applied load

PHOTO 5: Bracket under load

PHOTO 6: Test setup after test

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LABORATORY TEST REPORT

Uplift Tensile Load Test
Ceramic Tile Roof

CLIENT	CLIENT PROJECT REF. NO.	CLIENT ORDER NO.
Diversi-Tech Corporation	Bracket Test - Uplift Load	per S.A.

MATERIAL SUBMITTED BY	PNL PROJECT NO.	S.O. NO.	PNL LAB NO.	TEST DATE	REPORT DATE
Client	26-231261	001	ML845913	10/04/2023	10/13/2023

SAMPLE DESCRIPTION	TECHNICIANS
Tile roof w/ Universal L Foot Bracket & IR-T1 No Penetration Tile Roof Bracket	TR, MC, DG

TEST PROCEDURE/DESCRIPTION

The test specimen consisted of the solar panels, brackets, railing, and the simulation tile roof. The test specimen was visually examined for any damage or permanent deformation prior to testing. The uplift tensile pull load was applied after initial inspection was completed. Uplift load was applied using a chain hoist and a digital dynamometer. The load was applied at the center point of the cross beam. The cross beam was attached to the solar panel brackets. After the load was applied the specimen was examined for any damages or deformation. After examination the vertical load was released and the test specimen was examined again for any permanent deformation.

TEST DATA & EQUIPMENT INFORMATION

TEMPERATURE:	88 °F ± 3 °F	**HUMIDITY:**	15% ± 5%
TEST SPECIMEN SIZE:	Tile roof: 39.375 in. x 78.500 in.	**TEST SPECIMEN AREA:**	21.465 ft^2
LOAD TYPE:	Uplift tensile, applied with chain hoist	**TEST LOAD:**	710 lbf
EQUIPMENT TYPE:	Weightronic Dynamometer	**EQUIPMENT MODEL:**	OCS-Y / 3000 kg Max.
BRACKET COMPONENT 1:	Universal L Foot Bracket	**BRACKET PART NO. 1:**	IR-DMLF2000
BRACKET COMPONENT 2:	IR-T1 No Penetration Tile Roof Bracket	**BRACKET PART NO. 2:**	IR-FCTR1500

VISUAL TEST OBSERVATIONS

	INITIAL		UNDER UPLIFT TEST LOAD (710 lbf)		AFTER LOAD REMOVAL	
NO.	**BRACKET DEFORMATION**	**PANEL DEFORMATION**	**BRACKET DEFORMATION**	**PANEL DEFORMATION**	**BRACKET DEFORMATION**	**PANEL DEFORMATION**
1	None	None	Moderate	Moderate	None	None
2	None	None	Moderate	Moderate	None	None
3	None	None	Moderate	Severe	None	None
4	None	None	Moderate	Moderate	None	None

OBSERVATIONS

After removal of the uplift test load all brackets returned to original position with no permanent deformation noted.

The solar panel did not show any signs of permanent damage or deformation.

At Bracket No. 3, the tile roof shingle separated at the glue bond from the shingle underneath.

TECHNICIAN Timmy Pacyin REVIEWED BY Kyle Flagg

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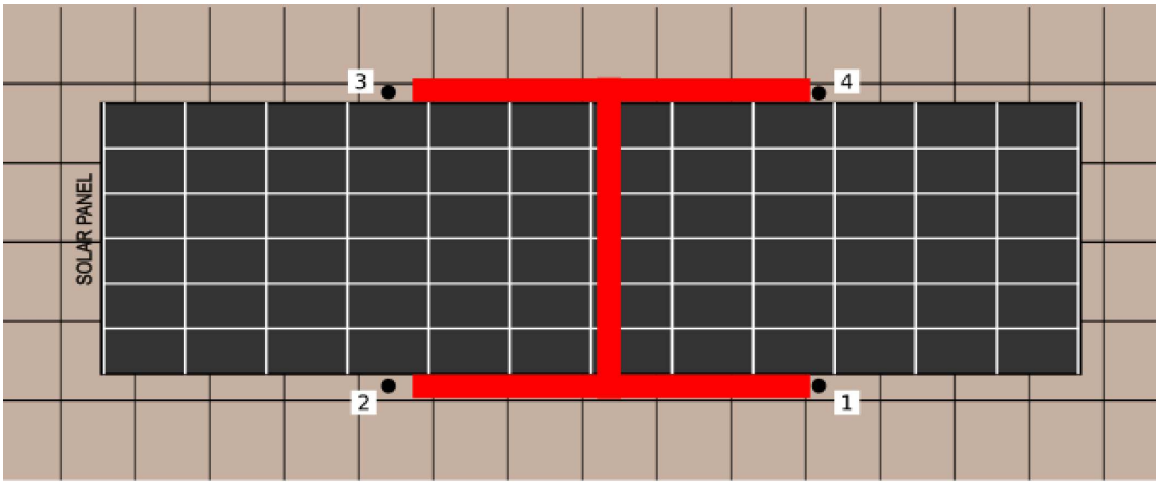
LABORATORY TEST REPORT

Uplift Tensile Load Test
Ceramic Tile Roof

CLIENT		CLIENT PROJECT REF. NO.			CLIENT ORDER NO.
Diversi-Tech Corporation		Bracket Test - Uplift Load			per S.A.
MATERIAL SUBMITTED BY	PNL PROJECT NO.	S.O. NO.	PNL LAB NO.	TEST DATE	REPORT DATE
Client	26-231261	001	ML845913	10/04/2023	10/13/2023
SAMPLE DESCRIPTION					TECHNICIANS
Tile roof w/ Universal L Foot Bracket & IR-T1 No Penetration Tile Roof Bracket					TR, MC, DG

SKETCH



● Bracket/Panel Gap Spacing Check

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LABORATORY TEST REPORT

Uplift Tensile Load Test
Ceramic Tile Roof

CLIENT		CLIENT PROJECT REF. NO.		CLIENT ORDER NO.	
Diversi-Tech Corporation		Bracket Test - Uplift Load		per S.A.	
MATERIAL SUBMITTED BY	PNL PROJECT NO.	S.O. NO.	PNL LAB NO.	TEST DATE	REPORT DATE
Client	26-231261	001	ML845913	10/04/2023	10/13/2023
SAMPLE DESCRIPTION					TECHNICIANS
Tile roof w/ Universal L Foot Bracket & IR-T1 No Penetration Tile Roof Bracket					TR, MC, DG

PHOTOS

PHOTO 1: Overview of solar panel and tile roof deck - before tests

PHOTO 2: Overview of tensile test setup and connection

PHOTO 3: Brackets with no load

PHOTO 4: Test setup

PHOTO 5: Test specimen while under tensile load

PHOTO 6: Dynamometer scale under load

PHOTO 7: Bracket under test load

PHOTO 8: Bracket unloaded after test

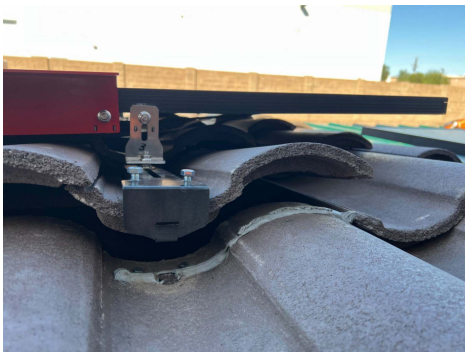

PHOTO 9: Bracket unloaded after test - roof tile bond pulled apart.