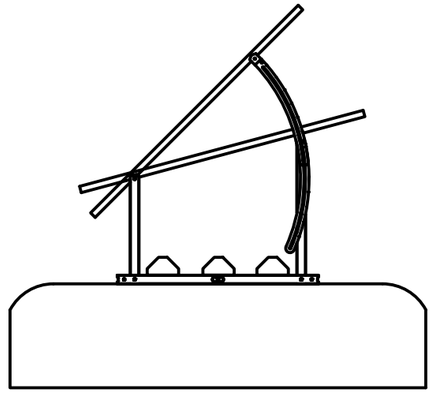
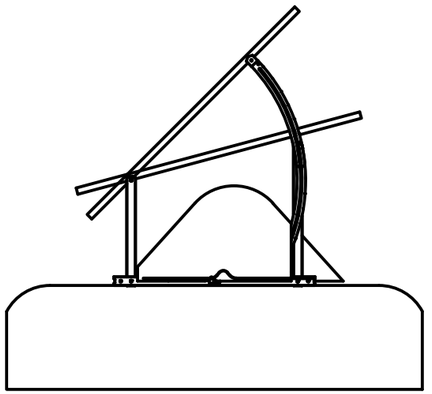
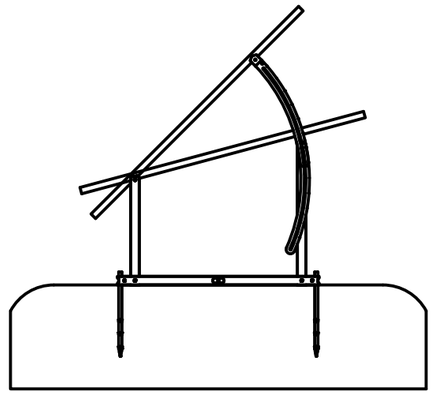
**Base Frame Ballasted:**
Three 175lb curb stop ballasts per solar module.
525lbs minimum per solar module for
70-80 mph windspeed at 45 degree angle.
(No stakes required)



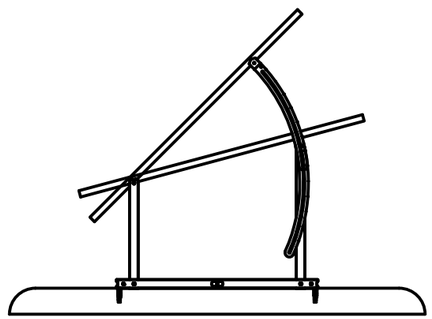
**IR EarthBallast™ System:**
22in fill to top of mound. 1200lbs
minimum per solar module.
Center of mound 6" offset toward rear leg.
(3/4" Steel concrete forming stakes required at
each end of base tube member)



**IR AnchorSpike™ System:**
Two AnchorSpikes per frame section
Medium/high density compacted soil required.
(1000lb minimum uplift test per AnchorSpike.
Not compatible in regions with frost depths
over 20 inches)



**Base Frame Bolted:**
Bolted to concrete footing,
concrete ballast pad, or steel beam.
(1200lbs minimum hold down per frame section)



***Images shown at 15 and 45 degrees positions**

PROJECT
# IntegraRack

TITLE
## IR-45ASA / ASAB Solar Racking System Data Sheet
6061 T6 Aluminum / Black Zinc Plated High Strength Steel

| | | | | | | |
|---|---|---|---|---|---|---|
| APPROVED | Paul Budge | 2/21/2025 | SIZE | CODE | DWG NO | REV |
| CHECKED | Paul Budge | 2/21/2025 | B | | | |
| DRAWN | Jeff Glauser | 2/21/2025 | SCALE 1:20 | WEIGHT | SHEET 1/4 | |

| Maximum Snow Load for All Angles | |
|---|---|
| **Module size up to 24 sqft** | **Module size up to 28 sqft** |
| 100 psf | 65 psf |

| 15 Degree Angle | | |
|---|---|---|
| **Maximum Wind Speed** | | |
| | **Module size up to 24 sqft** | **Module size up to 28 sqft** |
| Base Frame Ballasted | 100 mph | 85 mph |
| IR EarthBallast™ | 160 mph | 140 mph |
| IR AnchorSpike™ | 160 mph | 140 mph |
| Base Frame Bolted | 160 mph | 140 mph |

| 20 Degree Angle | | |
|---|---|---|
| **Maximum Wind Speed** | | |
| | **Module size up to 24 sqft** | **Module size up to 28 sqft** |
| Base Frame Ballasted | 90 mph | 80 mph |
| IR EarthBallast™ | 150 mph | 130 mph |
| IR AnchorSpike™ | 150 mph | 130 mph |
| Base Frame Bolted | 150 mph | 130 mph |

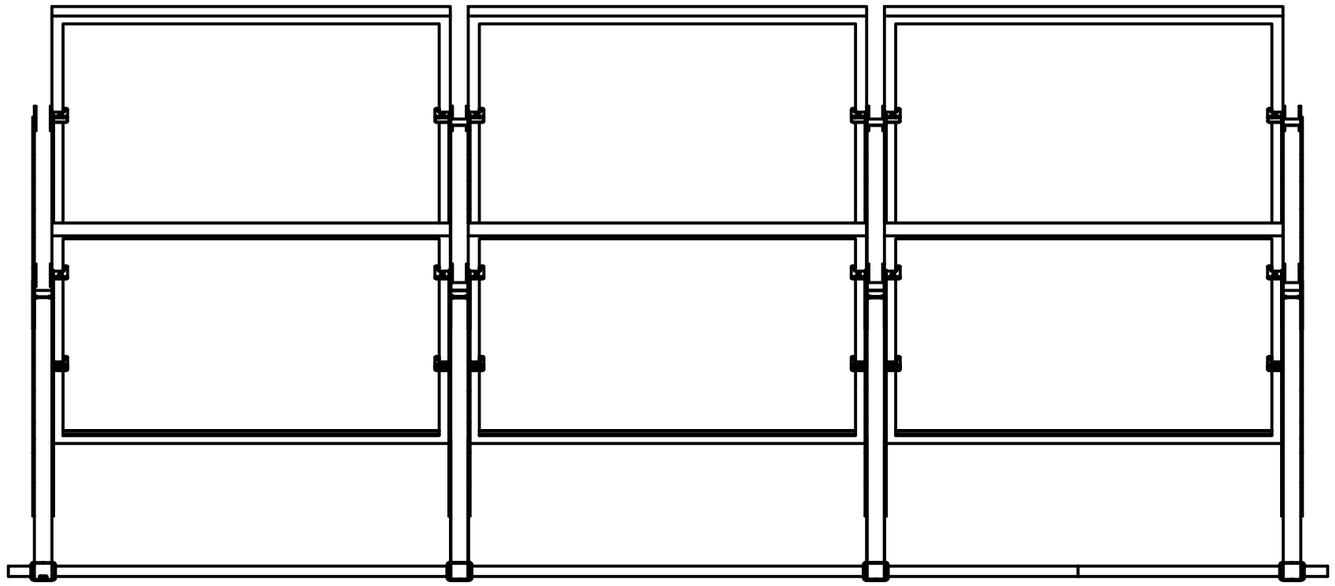
| 25 Degree Angle | | |
|---|---|---|
| **Maximum Wind Speed** | | |
| | **Module size up to 24 sqft** | **Module size up to 28 sqft** |
| Base Frame Ballasted | 85 mph | 75 mph |
| IR EarthBallast™ | 135 mph | 115 mph |
| IR AnchorSpike™ | 135 mph | 115 mph |
| Base Frame Bolted | 135 mph | 115 mph |

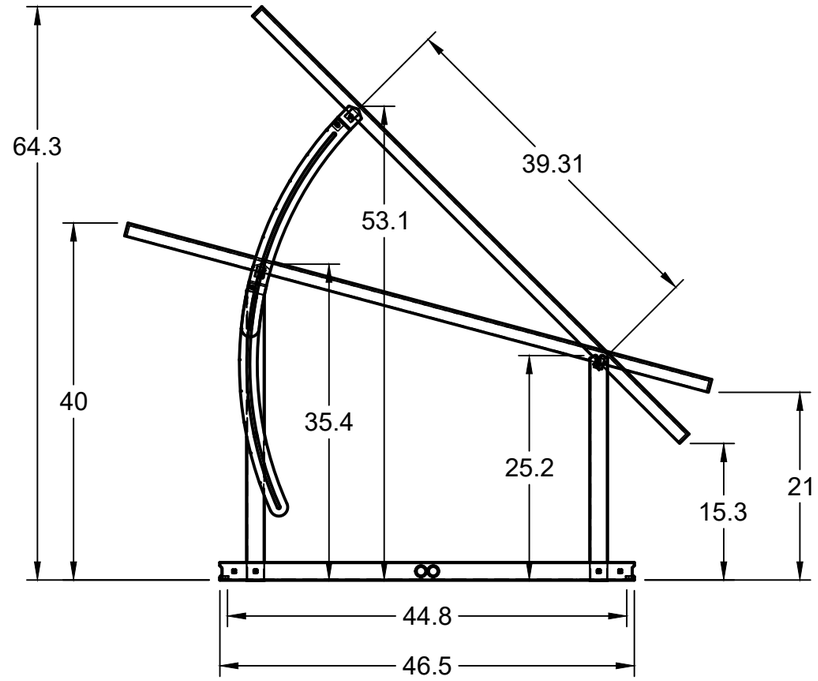
| 30 Degree Angle | | |
|---|---|---|
| **Maximum Wind Speed** | | |
| | **Module size up to 24 sqft** | **Module size up to 28 sqft** |
| Base Frame Ballasted | 80 mph | 70 mph |
| IR EarthBallast™ | 120 mph | 110 mph |
| IR AnchorSpike™ | 120 mph | 110 mph |
| Base Frame Bolted | 120 mph | 110 mph |

| 35 Degree Angle | | |
|---|---|---|
| **Maximum Wind Speed** | | |
| | **Module size up to 24 sqft** | **Module size up to 28 sqft** |
| Base Frame Ballasted | 75 mph | 65 mph |
| IR EarthBallast™ | 115 mph | 100 mph |
| IR AnchorSpike™ | 115 mph | 100 mph |
| Base Frame Bolted | 115 mph | 100 mph |

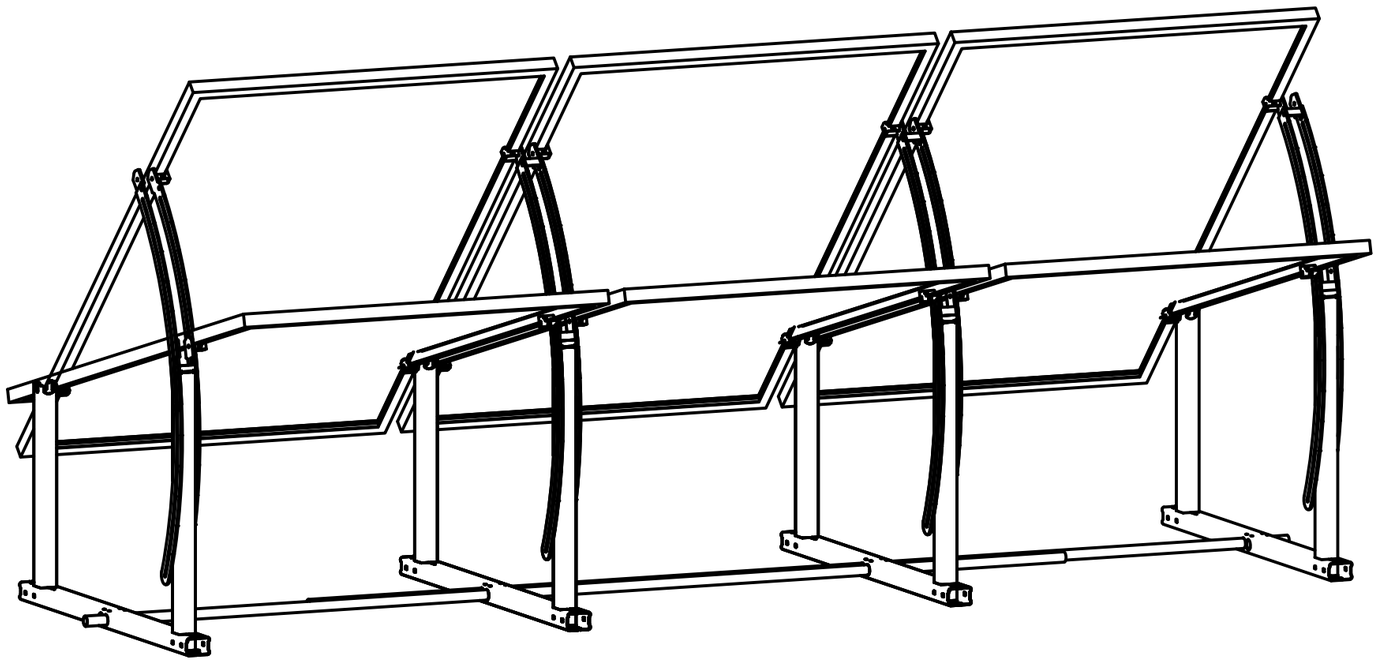
| 40 Degree Angle | | |
|---|---|---|
| **Maximum Wind Speed** | | |
| | **Module size up to 24 sqft** | **Module size up to 28 sqft** |
| Base Frame Ballasted | 70 mph | 60 mph |
| IR EarthBallast™ | 110 mph | 95 mph |
| IR AnchorSpike™ | 110 mph | 95 mph |
| Base Frame Bolted | 110 mph | 95 mph |

| 45 Degree Angle | | |
|---|---|---|
| **Maximum Wind Speed** | | |
| | **Module size up to 24 sqft** | **Module size up to 28 sqft** |
| Base Frame Ballasted | 65 mph | 55 mph |
| IR EarthBallast™ | 100 mph | 90 mph |
| IR AnchorSpike™ | 100 mph | 90 mph |
| Base Frame Bolted | 100 mph | 90 mph |






**AnchorSpike hole-to-hole dimension: 44.8 inches**



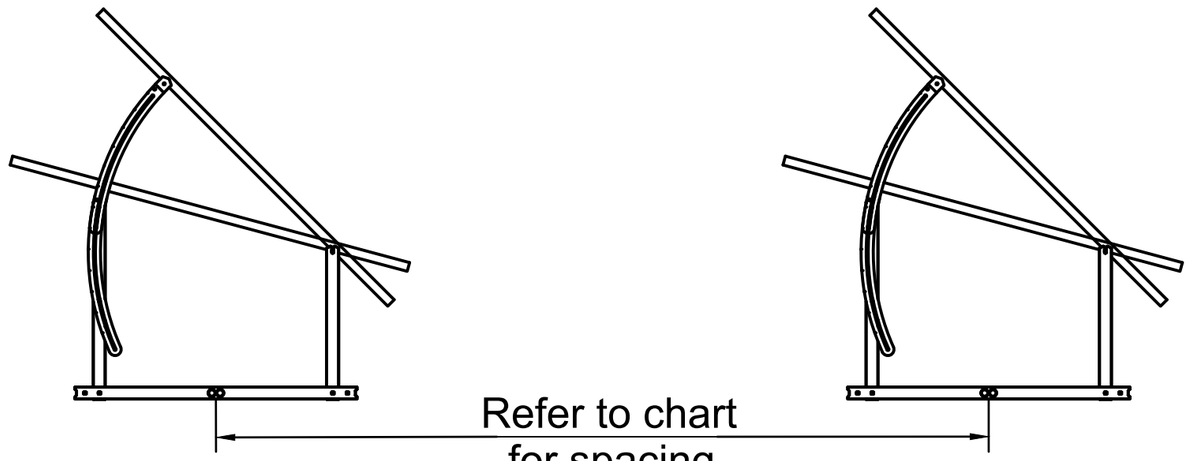
**Height off the ground and space between frames will vary based on module size and adjusment angle.**

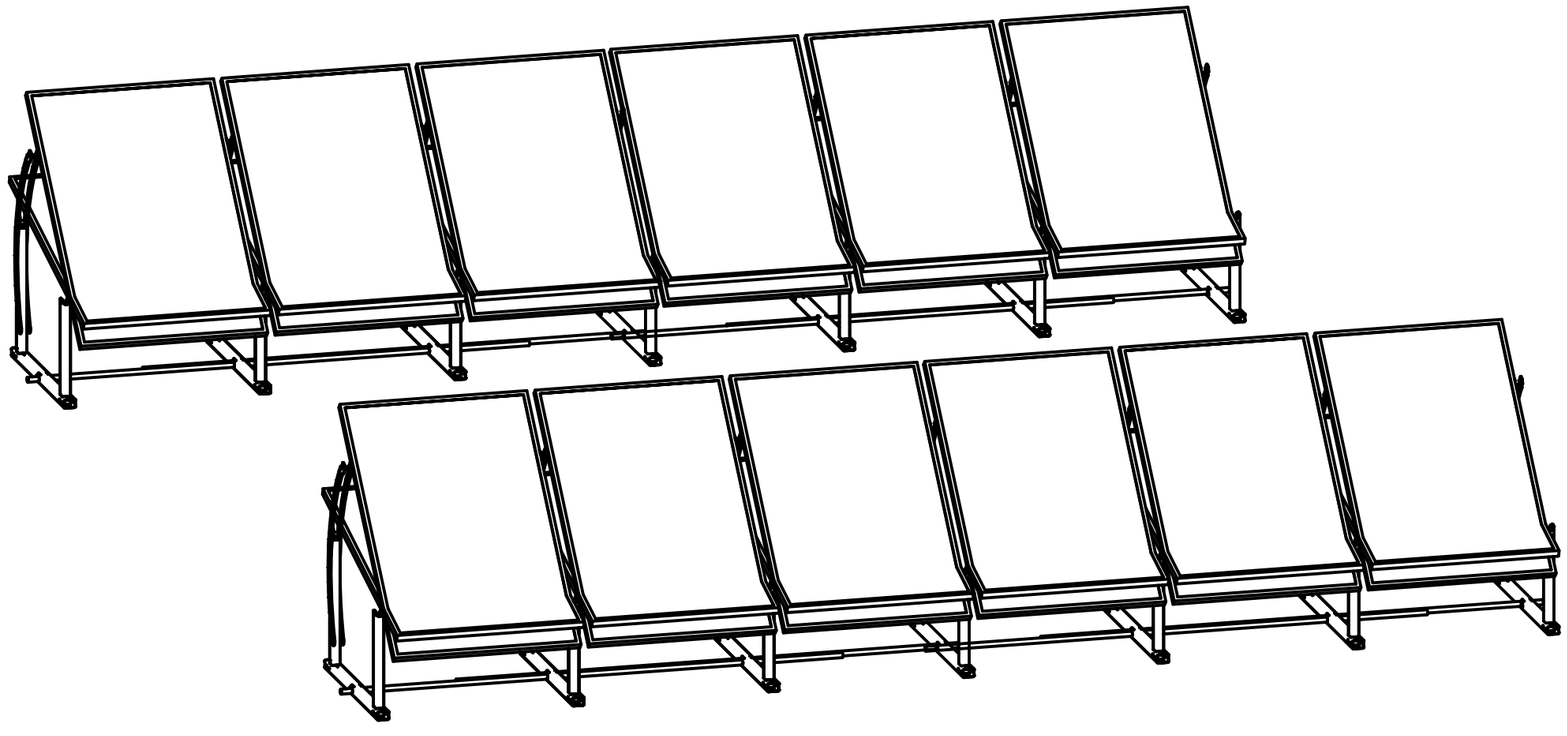
**(Solar module size represented is 44.7"x67.8")**

***Images shown at 15 and 45 degrees positions**

| REQUIRED SPACING BETWEEN ROWS | |
|---|---|
| 15 degrees | 10 feet 6 inches / 3.1 meters ON CENTER |
| 20 degrees | 11 feet 2 inches / 3.4 meters ON CENTER |
| 25 degrees | 11 feet 10 inches / 3.6 meters ON CENTER |
| 30 degrees | 12 feet 6 inches / 3.8 meters ON CENTER |
| 35 degrees | 12 feet 10 inches / 3.9 meters ON CENTER |
| 40 degrees | 13 feet 2 inches / 4 meters ON CENTER |
| 45 degrees | 13 feet 6 inches / 4.4 meters ON CENTER |

***Images shown at 15 and 45 degrees positions**



***The measurements listed above are from the center point of each base tube.**

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April 24, 2024
Mr. Paul Budge
Diversi-Tech Corp - IntegraRack
PO Box 910758
St. George, UT 84791

Subject: Simulated Wind Load, Snow Load, and Horizontal Racking Load Testing on IR-30 Solar Racking System.

Dear Mr. Budge,

Please find included our test reports for the simulated wind load (tensile load), snow load (compression load) and horizontal racking load tests of the IR-30 Solar Racking System performed on 3/20/2024 - 03/22/2024 in St. George, Utah.

The first simulated wind load test was performed on the IR-30 Solar Racking System Ground Frame that had two solar panels installed at a 30 ° angle and utilized the EarthBallast System. The load was applied via a crossbar connected to the solar panels which were then connected to the ground frame using the IR-F2 Under Mount Flange Clamp Bracket. The test was performed in two parts with the first part used ballast of two loose fill dirt loads from a skid steer, approximately 11 $ft^3$ total volume, and then the second part used a total of three loads for a total volume of approximately 14 $ft^3$. The IR-30 Solar Racking system was monitored for movement as the simulated wind load tensile force was applied. Test loads were measured using a calibrated Dyna-Link 2 Dynamometer (SN 100326, Cal. Date 10/13/2023). Test run details are shown in the table below.

| SIMULATED WIND LOAD (TENSILE UPLIFT) FORCE INSPECTION DETAILS | | | | | |
|---|---|---|---|---|---|
| TEST NO. | BALLAST DETAILS | | VISUAL OBSERVATIONS | | |
| | SIZE (LxWxH) (in.) | CALCULATED WEIGHT (lbf) | UPLIFT TENSILE FORCE AT INITIAL FRAME MOVEMENT (lbf) | UPLIFT TENSILE FORCE AT FRAME AND BALLAST MOVEMENT (lbf) | MAX. FORCE REACHED (lbf) |
| 1 | 96 in. x 18 in. x 11 in. (11 CF) | 1100 lbf (2 skid steer buckets) | 800 | 880 | 1045 |
| 2 | 92 in. x 42 in. x 14 in. (14 CF) | 1400 lbf (3 skid steer buckets) | 965 | 1065 | 1235 |

The horizontal racking load test was performed on the same IR-30 Solar Racking System Ground Frame that had two solar panels installed at a 30 ° angle and utililized the EarthBallast System and three loads of loose fill dirt ballast. A lifting strap was used to wrap around the panel and run parallel to the frame in order to apply the horizontal racking force. The system was monitored for movement as the simulated load was applied and the maximum load was recorded. The system held the load and no damage or permanent deformation was noted as detailed in the test observations table below.

| SIMULATED HORIZONTAL RACKING FORCE INSPECTION DETAILS | | | | |
|---|---|---|---|---|
| TEST NO. | BALLAST DETAILS | | MAX. HORIZONTAL FORCE (lbf) | OBSERVATIONS |
| | SIZE (LxWxH) (in.) | WEIGHT (lbf) | | |
| 1 | 90 in. x 42 in. x 14 in. (14 CF) | ~ 1400 lbf (3 skid steer buckets) | 645 | Test was stopped at 645 lbf. No damage or movement was visually noted. |

The simulated snow load test was performed on a IR-30 Solar Racking System Ground Frame that was installed with two

short uprights so that the solar panel would be held parallel to the ground. The solar panel was attached to the ground frame using the IR-F2 Under Mount Flange Clamp Bracket. The load was applied using a large water tank that weighed 2410 lbf. The weight was recorded using the calibrated Dyna-Link 2 Dynamometer (SN 100326, Cal. Date 10/13/2023). The load was set on the frame and left overnight. The following day the load was increased by adding a total of twelve 5 gallon water jugs. The jugs were filled and weigh approximately 45 lbf per jug for a total weight of 2950 lbf. The frame held all loads and visual observations of the frame and components were recorded and shown in the table below.

| SIMULATED SNOW LOAD (COMPRESSIVE LOAD) INSPECTION DETAILS | | | |
|---|---|---|---|
| | COMPRESSIVE FORCE | | OBSERVATIONS |
| | DESCRIPTION | WEIGHT (lbf) | |
| 1 | Large water tank | 2410 | Solar panel held load overnight (> 10 h). |
| 2 | Large water tank + (12) five gallon jugs | 2950 | Solar panel held load, ~ 10 -15 minutes under observation. Slight deflections noted under load (See Photos). Minor permanent deformation noted after load removal (See Photos). The alignment tabs in the vertical uprights were no longer flat with the uprights. |

The final simulated wind load test was performed on the IR-30 Solar Racking System Ground Frame that had two solar panels installed at a 30 ° angle and utililized the small IR AnchorSpikes and no earth ballast. The load was applied via a crossbar connected to the solar panels which were then connected to the ground frame using the IR-F2 Under Mount Flange Clamp Bracket. The load was applied until failure of a solar panel at 2385 lbf. Visual observations noted that the frame had visibly moved and shifted forward initially at 1500 lbf but continued to hold load as detailed in the table below.

| SIMULATED WIND LOAD (TENSILE UPLIFT) FORCE INSPECTION DETAILS | | |
|---|---|---|
| TEST NO. | MAX. FORCE (lbf) | OBSERVATIONS |
| 1 | 2385 | At 1500 lbf the frame visibly shifted and started to roll forward.<br><br>At 2385 lbf one of the solar panels failed and shattered (Photos 7-9). The frame and brackets holding the solar panel kept it in place and were permanently deformed. The aluminum tube upright had bent forward and outward causing the seam of the tube to tear and it allowed the through bolt to come free. Two mounting brackets permanently deformed and there was additional permanent deformation in the base frame (Photos 10-15) |

Test reports with additional details, photos, and data have been attached.

Respectfully submitted,
**PHOENIX NATIONAL LABORATORIES, INC.**

Kyle Fleege, P.E.
Project Manager / Mechanical Engineer
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# INSPECTION AND TEST REPORT

**PNL REF. #** 26-240383 **S.O. #** 001 **INDEX** 03
**INSPECTION DATE** 03/20/2024
IR-30 Ground Frame w/ EarthBallast: Simulated Wind Load



| CLIENT | CLIENT PROJECT REFERENCE | CLIENT ORDER NO. |
|---|---|---|
| IntegraRack | IR-30 Solar Racking System w/ Earth Ballast - Simulated Wind | per S.A. |

| SAMPLE DESCRIPTION | TEST LOCATION | TECHNICIANS |
|---|---|---|
| IR-30 Solar Racking System w/ Earth Ballast | St. George, UT | Weston A. |

## TEST CONDITIONS & EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TEMPERATURE:** | 65 °F ± 10 °F | **HUMIDITY:** | 30% ± 10% |
| **LOAD TYPE:** | Simulated Wind Load - Tensile / Uplift | **TEST LOAD:** | Record |
| **EQUIPMENT TYPE:** | Dyna-Link 2 Dynamometer MSI-7300RF | **S/N & CALIBRATION DATE:** | S/N 100326; CAL 10/13/2023 |
| **SKID STEER MODEL:** | Kubota SSV65 | | |

## TEST SPECIMEN & COMPONENT INFORMATION

| | | | |
|---|---|---|---|
| **TEST SPECIMEN:** | IR-30 Solar Racking System | **ID NO.:** | IR-30RF1000 |
| **SOLAR PANELS SIZE:** | 39.25 in. x 66 in. | **TEST SPECIMEN AREA:** | 17.989 $ft^2$ |
| **SYSTEM COMPONENT 1:** | IRF2 Under Mount Flange Clamp Bracket | **PART NO. 1:** | IR-FCCM0500 |
| **SYSTEM COMPONENT 2:** | Large IR-30 Frame Upright | **PART NO. 2:** | IRP-30LL1000-T |
| **SYSTEM COMPONENT 3:** | Small IR-30 Frame Upright | **PART NO. 3:** | IRP-30SL1000-T |
| **SYSTEM COMPONENT 4:** | IR-30 Base Tube | **PART NO. 4:** | IRP-30BT1000-T |
| **SYSTEM COMPONENT 5:** | Connecting Rod | **PART NO. 5:** | None - 1" EMT pipe |

## SIMULATED WIND LOAD (TENSILE UPLIFT FORCE) TEST PROCEDURE/DESCRIPTION

The IR-30 Solar Racking System Ground Frame was installed with two solar panels and the IR EarthBallast System. The system utilizes a mesh that is epoxied to the frame which is then loaded with dirt (ballast) that supports and holds down the frame (Photo 3). The system was tested with 2 Kubota SSV75 skid steer loads of dirt loaded for Test 1 and 3 loads for Test 2. Load was applied via a red crossbar that was fastened to the edges of the solar panel frames that was connected to the ground frame via the IRF2 Under Mount Flange Clamp Bracket. The skid steer dirt loads were estimated at approximately 500 lbf each using an estimated 100 $lb/ft^3$ for the density of the soil. The actual density of the soil is unknown.

The solar panels were set at an approximate 30° angle. The tensile force was applied upwards and away, at a perpendicular angle from the solar panels using the skid steer (Photo 4). Load was monitored with the digital dynamometer. Load was recorded when an initial shift of the solar panel frame was noted and when the shift was large enough to cause visual changes to the frame and in the ballast surface (Photos 5-13).

## SIMULATED WIND LOAD (TENSILE UPLIFT) FORCE INSPECTION DETAILS

| TEST NO. | BALLAST DETAILS | | VISUAL OBSERVATIONS | | |
|---|---|---|---|---|---|
| | SIZE (LxWxH) (in.) | CALCULATED WEIGHT (lbf) | UPLIFT TENSILE FORCE AT INITIAL FRAME MOVEMENT (lbf) | UPLIFT TENSILE FORCE AT FRAME AND BALLAST MOVEMENT (lbf) | MAX. FORCE REACHED (lbf) |
| **1** | 96 in. x 18 in. x 11 in. (11 CF) | 1100 lbf (2 skid steer buckets) | 800 | 880 | 1045 |
| **2** | 92 in. x 42 in. x 14 in. (14 CF) | 1400 lbf (3 skid steer buckets) | 965 | 1065 | 1235 |

TECHNICIAN Weston Allen

REVIEWED BY Kyle Flagg

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# INSPECTION AND TEST REPORT

**PNL REF. #** 26-240383 **S.O. #** 001 **INDEX** 03
**INSPECTION DATE** 03/20/2024
IR-30 Ground Frame w/ EarthBallast: Simulated Wind Load



| CLIENT | CLIENT PROJECT REFERENCE | CLIENT ORDER NO. |
|---|---|---|
| IntegraRack | IR-30 Solar Racking System w/ Earth Ballast - Simulated Wind | per S.A. |
| **SAMPLE DESCRIPTION** | **TEST LOCATION** | **TECHNICIANS** |
| IR-30 Solar Racking System w/ Earth Ballast | St. George, UT | Weston A. |

## PHOTOS


**PHOTO 1:** Dynamometer used to record loads

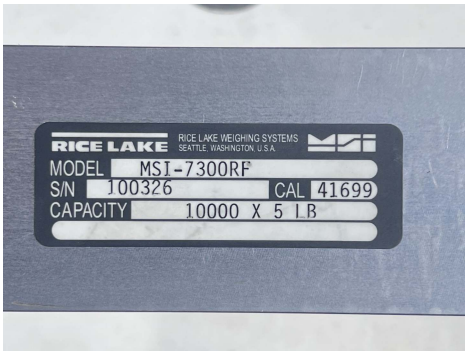


**PHOTO 2:** Dynamometer ID label

**PHOTO 3:** Test setup - IR-30 Solar Racking System with red test cross frame

**PHOTO 4:** Test setup with dynamometer and chains connected

**PHOTO 5:** Test 1 - Evidence of ballast shift

**PHOTO 6:** Test 1 - Load at ballast shift

**PHOTO 7:** Test 1 - Max load

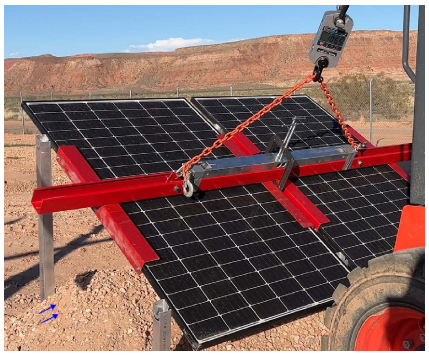

**PHOTO 8:** Test 2 - Evidence of ballast shift

**PHOTO 9:** Test 2 - Evidence of ballast shift

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# INSPECTION AND TEST REPORT

**PNL REF. #** 26-240383 **S.O. #** 001 **INDEX** 03
**INSPECTION DATE** 03/20/2024
IR-30 Ground Frame w/ EarthBallast: Simulated Wind Load



| CLIENT | CLIENT PROJECT REFERENCE | CLIENT ORDER NO. |
|---|---|---|
| IntegraRack | IR-30 Solar Racking System w/ Earth Ballast - Uplift Force | per S.A. |
| **SAMPLE DESCRIPTION** | **TEST LOCATION** | **TECHNICIANS** |
| IR-30 Solar Racking System w/ Earth Ballast | St. George, UT | Weston A. |

## PHOTOS

**PHOTO 10:** Test 2 - Load at ballast shift

**PHOTO 11:** Test 2 - Max load

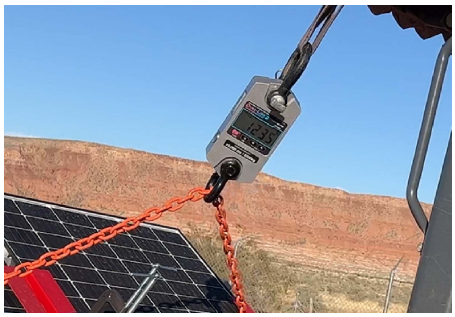

**PHOTO 12:** Test 2 - Max load

**PHOTO 13:** Ballast after completion of testing

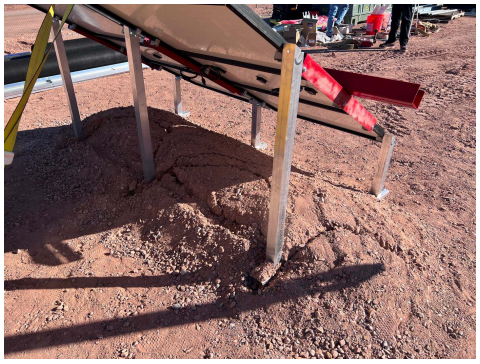

**PHOTO 14:** Ballast and frame after completion of testing

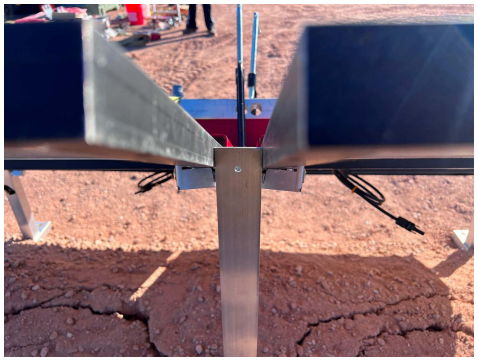

**PHOTO 13:** IR-F2 Clamp bracket after completion of testing

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# INSPECTION AND TEST REPORT

**PNL REF. #** 26-240383 **S.O. #** 001 **INDEX** 03
**INSPECTION DATE** 03/20/2024
IR-30 Ground Frame w/ EarthBallast: Horizontal Racking Load



| CLIENT | CLIENT PROJECT REFERENCE | CLIENT ORDER NO. |
|---|---|---|
| IntegraRack | IR-30 Solar Racking System w/ Earth Ballast - Horizontal Racking | per S.A. |

| SAMPLE DESCRIPTION | TEST LOCATION | TECHNICIANS |
|---|---|---|
| IR-30 Solar Racking System w/ Earth Ballast | St. George, UT | Weston A. |

## TEST CONDITIONS & EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TEMPERATURE:** | 65 °F ± 10 °F | **HUMIDITY:** | 30% ± 10% |
| **LOAD TYPE:** | Horizontal Racking Load | **TEST LOAD:** | Record |
| **EQUIPMENT TYPE:** | Dyna-Link 2 Dynamometer MSI-7300RF | **S/N & CALIBRATION DATE:** | S/N 100326; CAL 10/13/2023 |
| **SKID STEER MODEL:** | Kubota SSV65 | | |

## TEST SPECIMEN & COMPONENT INFORMATION

| | | | |
|---|---|---|---|
| **TEST SPECIMEN:** | IR-30 Solar Racking System | **ID NO.:** | IR-30RF1000 |
| **SOLAR PANELS SIZE:** | 39.25 in. x 66 in. | **TEST SPECIMEN AREA:** | 17.989 $ft^2$ |
| **SYSTEM COMPONENT 1:** | IRF2 Under Mount Flange Clamp Bracket | **PART NO. 1:** | IR-FCCM0500 |
| **SYSTEM COMPONENT 2:** | Large IR-30 Frame Upright | **PART NO. 2:** | IRP-30LL1000-T |
| **SYSTEM COMPONENT 3:** | Small IR-30 Frame Upright | **PART NO. 3:** | IRP-30SL1000-T |
| **SYSTEM COMPONENT 4:** | IR-30 Base Tube | **PART NO. 4:** | IRP-30BT1000-T |
| **SYSTEM COMPONENT 5:** | Connecting Rod | **PART NO. 5:** | None - 1" EMT pipe |

## HORIZONTAL RACKING FORCE TEST PROCEDURE/DESCRIPTION

The IR-30 Solar Racking System Ground Frame was installed with the IR EarthBallast System and two solar panels. The EarthBallast system utilizes a mesh that is epoxied to the frame which is then loaded with loose dirt fill (ballast) that supports and holds down the frame. The horizontal load test was performed after the vertical uplift tensile load test. The system was tested with 3 loads of dirt from a Kubota SSV75 skid steer. The skid steer dirt loads were estimated at ~ 500 lbf each using an estimate of 100 $lb/ft^3$ for the density of soil. A lifting strap was wrapped around the panel lengthwise and run parallel to the frame in order to apply a horizontal force to the system (Photos). Force was applied using the skid steer and load was monitored with the digital dynamometer. The test was stopped at a load of 645 lbf. No movement or damage was visually noted during or after the test.

## HORIZONTAL RACKING FORCE INSPECTION DETAILS

| TEST NO. | BALLAST DETAILS | | MAX. HORIZONTAL FORCE (lbf) | OBSERVATIONS |
|---|---|---|---|---|
| | SIZE (LxWxH) (in.) | WEIGHT (lbf) | | |
| 1 | 90 in. x 42 in. x 14 in. (14 CF) | ~ 1400 lbf (3 skid steer buckets) | 645 | Test was stopped at 645 lbf. No damage or movement was visually noted. |

TECHNICIAN 

REVIEWED BY 

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# INSPECTION AND TEST REPORT

**PNL REF. #** 26-240383 **S.O. #** 001 **INDEX** 03
**INSPECTION DATE** 03/20/2024
IR-30 Ground Frame w/ EarthBallast: Horizontal Racking Load



| CLIENT | CLIENT PROJECT REFERENCE | CLIENT ORDER NO. |
|---|---|---|
| IntegraRack | IR-30 Solar Racking System w/ Earth Ballast - Horizontal Racking | per S.A. |
| **SAMPLE DESCRIPTION** | **TEST LOCATION** | **TECHNICIANS** |
| IR-30 Solar Racking System w/ Earth Ballast | St. George, UT | Weston A. |

## PHOTOS

**PHOTO 1:** Horizontal force test setup

**PHOTO 2:** Horizontal force test setup

**PHOTO 3:** Horizontal force test setup

**Photo 4:** Horizontal force test at max load

**Photo 4:** Horizontal force test max load

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# INSPECTION AND TEST REPORT

**PNL REF. #** 26-240383 **S.O. #** 001 **INDEX** 03
**INSPECTION DATE** 03/20/2024
IR-30 Ground Frame: Simulated Snow Load



| CLIENT | CLIENT PROJECT REFERENCE | CLIENT ORDER NO. |
|---|---|---|
| IntegraRack | IR-30 Solar Racking System - Simulated Snow Load | pefr S.A. |
| **SAMPLE DESCRIPTION** | **TEST LOCATION** | **TECHNICIANS** |
| IR-30 Solar Racking System w/ 1 solar panel | St. George, UT | Weston A. |

## TEST CONDITIONS & EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TEMPERATURE:** | 65 °F ± 10 °F | **HUMIDITY:** | 30% ± 10% |
| **LOAD TYPE:** | Simulated Snow Load - Compressive | **TEST LOAD:** | Record |
| **EQUIPMENT TYPE:** | Dyna-Link 2 Dynamometer MSI-7300RF | **S/N & CALIBRATION DATE:** | S/N 100326; CAL 10/13/2023 |
| **WATER TANK WEIGHT:** | 2410 lbf | | |

## TEST SPECIMEN & COMPONENT INFORMATION

| | | | |
|---|---|---|---|
| **TEST SPECIMEN:** | IR-30 Solar Racking System | **ID NO.:** | IR-30RF1000 |
| **SOLAR PANELS SIZE:** | 39.25 in. x 66 in. | **TEST SPECIMEN AREA:** | 17.989 $ft^2$ |
| **SYSTEM COMPONENT 1:** | IRF2 Under Mount Flange Clamp Bracket | **PART NO. 1:** | IR-FCCM0500 |
| **SYSTEM COMPONENT 2:** | Small IR-30 Frame Upright | **PART NO. 2:** | IRP-30SL1000-T |
| **SYSTEM COMPONENT 3:** | Small IR-30 Frame Upright | **PART NO. 3:** | IRP-30SL1000-T |
| **SYSTEM COMPONENT 4:** | IR-30 Base Tube | **PART NO. 4:** | IRP-30BT1000-T |
| **SYSTEM COMPONENT 5:** | Connecting Rod | **PART NO. 5:** | None - 1" EMT pipe |

## SIMULATED SNOW LOAD (COMPRESSIVE LOAD) TEST PROCEDURE/DESCRIPTION

The IR-30 Solar Racking System Ground Frame was installed using only the short uprights so that the solar panel, size 39-1/4 in.x 66 in., would be flat and parallel to the ground (Photo). Solar panel frames were connected to the ground frame via the IRF2 Under Mount Flange Clamp Bracket. The 1st part of the test was placing the large water tank directly on top of the solar panels and leaving it overnight. Two aluminum rectangular tubes were placed along the longitudinal edge of the solar panel for the water tank to be placed on so that the load was distributed to both sides of the frame (Photo). The 2nd part of the test involved adding 12 additional 5 gallon water jugs. The same 5 gallon jugs had been filled with water and weighed on PNL's calibrated universal test machines for previous tests (See PNL Report 26-231261.001 (dated 10/13/2023) for Compression Load Test) and had an average weight of 45.31 lbf so an average weight of 45 lbf was assumed for the full water jugs.

## SIMULATED SNOW LOAD (COMPRESSIVE LOAD) INSPECTION DETAILS

| | COMPRESSIVE FORCE | | OBSERVATIONS |
|---|---|---|---|
| | **DESCRIPTION** | **WEIGHT (lbf)** | |
| **1** | Large water tank | 2410 | Solar panel held load overnight (> 10 h). |
| **2** | Large water tank + (12) five gallon jugs | 2950 | Solar panel held load, ~ 10 -15 minutes under observation. Slight deflections noted under load (See Photos). Minor permanent deformation noted after load removal (See Photos). The alignment tabs in the vertical uprights were no longer flat with the uprights. |

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# INSPECTION AND TEST REPORT

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|---|---|---|
| IntegraRack | IR-30 Solar Racking System - Snow Load / Compression Load | per S.A. |
| SAMPLE DESCRIPTION | | TECHNICIANS |
| Horizontal Load Test on IR-30 Ground Frame Earth Ballast | | Weston A. |

## PHOTOS

**PHOTO 1:** Weighing the large water tank

**PHOTO 2:** Large water tank weight

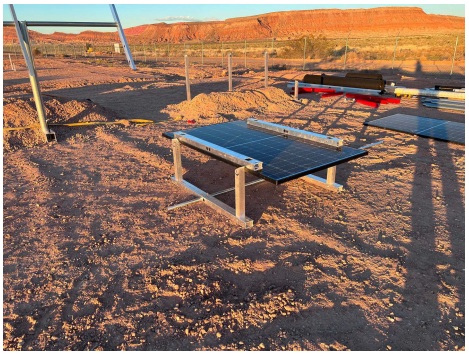

**PHOTO 3:** IR-30 Solar Racking System setup for test

**PHOTO 4:** Setting initial load

**PHOTO 5:** 2nd test - large tank + 12 five gallon jugs

**PHOTO 6:** Slight deflection under load

**PHOTO 7:** Slight deflections noted under load

**PHOTO 8:** Slight deflection noted under load

**PHOTO 9:** IR-30 system after compressive load tests

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|---|---|---|
| IntegraRack | IR-30 Solar Racking System - Snow Load / Compression Load | per S.A. |
| SAMPLE DESCRIPTION | | TECHNICIANS |
| Horizontal Load Test on IR-30 Ground Frame Earth Ballast | | Weston A. |

**PHOTO 10:** Slight deformation after load removed

**PHOTO 11**: Slight deformation after load removed

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# INSPECTION AND TEST REPORT

**PNL REF. #** 26-240383 **S.O. #** 001 **INDEX** 03
**INSPECTION DATE** 03/21/2024
IR-30 Ground Frame w/ AnchorSpikes: Simulated Wind Load



| CLIENT | CLIENT PROJECT REFERENCE | CLIENT ORDER NO. |
|---|---|---|
| IntegraRack | IR-30 Solar Racking System w/ Anchor Spikes - Simulated Wind | per S.A. |
| **SAMPLE DESCRIPTION** | **TEST LOCATION** | **TECHNICIANS** |
| IR-30 Solar Racking System w/ AnchorSpikes | St. George, UT | Weston A. |

## TEST CONDITIONS & EQUIPMENT INFORMATION

| | | | |
|---|---|---|---|
| **TEMPERATURE:** | 65 °F ± 10 °F | **HUMIDITY:** | 30% ± 10% |
| **LOAD TYPE:** | Wind Load - Tensile / Uplift | **TEST LOAD:** | Record |
| **EQUIPMENT TYPE:** | Dyna-Link 2 Dynamometer MSI-7300RF | **S/N & CALIBRATION DATE:** | S/N 100326; CAL 10/13/2023 |
| **SKID STEER MODEL:** | Kubota SSV65 | | |

## TEST SPECIMEN & COMPONENT INFORMATION

| | | | |
|---|---|---|---|
| **TEST SPECIMEN:** | IR-30 Solar Racking System | **ID NO.:** | IR-30RF1000 |
| **SOLAR PANELS SIZE:** | 39.25 in. x 66 in. | **TEST SPECIMEN AREA:** | 17.989 $ft^2$ |
| **SYSTEM COMPONENT 1:** | IRF2 Under Mount Flange Clamp Bracket | **PART NO. 1:** | IR-FCCM0500 |
| **SYSTEM COMPONENT 2:** | Large IR-30 Frame Upright | **PART NO. 2:** | IRP-30LL1000-T |
| **SYSTEM COMPONENT 3:** | Small IR-30 Frame Upright | **PART NO. 3:** | IRP-30SL1000-T |
| **SYSTEM COMPONENT 4:** | IR-30 Base Tube | **PART NO. 4:** | IRP-30BT1000-T |
| **SYSTEM COMPONENT 5:** | Connecting Rod | **PART NO. 5:** | None - 1" EMT pipe |
| **SYSTEM COMPONENT 6:** | IR AnchorSpikes - 19.5 | **PART NO. 6:** | 19.5 in. Barbed aluminum spikes |

## SIMULATED WIND LOAD (TENSILE UPLIFT) FORCE TEST PROCEDURE/DESCRIPTION

The IR-30 Solar Racking System Ground Frame was installed using the small IR AnchorSpikes (Photo 3) and two part epoxy system. The AnchorSpike installation consists of pounding the anchors into the ground, filling with the two part epoxy system, and then clamping the anchors to the frame with the built in clamps. Load was applied via a red crossbar that was fastened to the edges of the solar panel frames that was connected to the ground frame via the IRF2 Under Mount Flange Clamp Bracket.

The solar panels were set at an approximate 30° angle. The tensile force was applied upwards and away, at a perpendicular angle from the solar panels using the skid steer (Photo 6). Displacement measurements were recorded before and after the load test at the anchor spike locations (Photos 4-5). Load was monitored with the digital dynamometer (Photos 1-2).

## SIMULATED WIND LOAD (TENSILE UPLIFT) FORCE TEST ANCHORSPIKE AND FRAME DISPLACEMENT

| | Spike #1 | | Spike #2 | | Spike #3 | | Spike #4 | | Spike #5 | | Spike #6 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **Stickout (in.)** | **Ground to Frame (in.)** | **Stickout (in.)** | **Ground to Frame (in.)** | **Stickout (in.)** | **Ground to Frame (in.)** | **Stickout (in.)** | **Ground to Frame (in.)** | **Stickout (in.)** | **Ground to Frame (in.)** | **Stickout (in.)** | **Ground to Frame (in.)** |
| **Initial** | 2.188 | 1.250 | 2.250 | 1.125 | 2.625 | 1.000 | 2.250 | 0.500 | 2.000 | 1.625 | 2.438 | 1.063 |
| **Final** | 2.250 | 1.250 | 2.250 | 1.125 | 2.563 | 1.125 | 2.563 | 0.750 | 1.938 | 1.625 | 2.250 | 1.375 |

## SIMULATED WIND LOAD (TENSILE UPLIFT) FORCE INSPECTION DETAILS

| TEST NO. | MAX. FORCE (lbf) | OBSERVATIONS |
|---|---|---|
| 1 | 2385 | At 1500 lbf the frame visibly shifted and started to roll forward.<br><br>At 2385 lbf one of the solar panels failed and shattered (Photos 7-9). The frame and brackets holding the solar panel kept it in place and were permanently deformed. The aluminum tube upright had bent forward and outward causing the seam of the tube to tear and it allowed the through bolt to come free. Two mounting brackets permanently deformed and there was additional permanent deformation in the base frame (Photos 10-15) |

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# INSPECTION AND TEST REPORT

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| **SAMPLE DESCRIPTION** | **TEST LOCATION** | **TECHNICIANS** |
| IR-30 Solar Racking System w/ AnchorSpikes | St. George, UT | Weston A. |

## PHOTOS


**PHOTO 1:** Dynamometer used to record loads

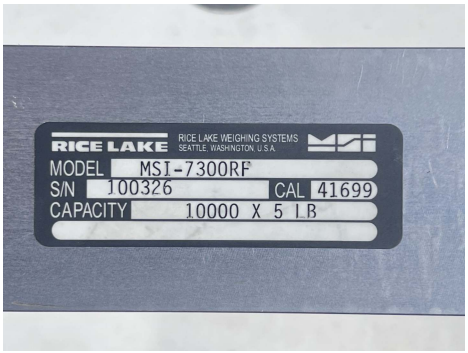


**PHOTO 2:** Dynamometer ID label

**PHOTO 3:** AnchorSpikes. The small AnchorSpike was used for setup in this test

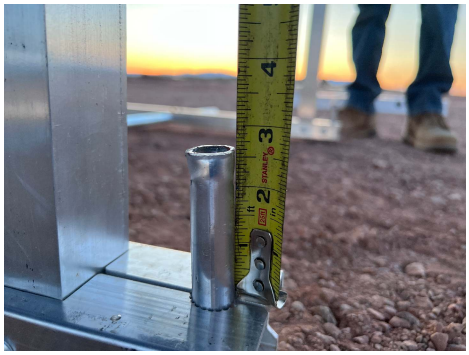

**PHOTO 4:** 'Stickout' measurement example at Spike #3

**PHOTO 5:** Ground to frame measurement example at Spike #3

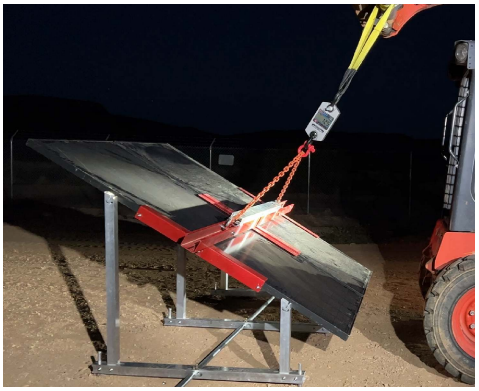

**PHOTO 6:** Test setup - IR-30 Solar Racking System with AnchorSpikes

**PHOTO 7:** IR-30 Solar Racking System at max load

**PHOTO 8:** Closeup of max load, 2385 lbf

**PHOTO 9:** IR-30 Solar Racking System right after max load when panel failed

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| IR-30 Solar Racking System w/ AnchorSpikes | St. George, UT | Weston A. |

## PHOTOS

**PHOTO 10:** Solar panels after testing

**PHOTO 11:** Frame after testing

**PHOTO 12:** Middle brackets after testing

**PHOTO 13:** Bracket deformation after testing

**PHOTO 14:** Upright mount deformation after testing

**PHOTO 15:** Upright deformation after testing