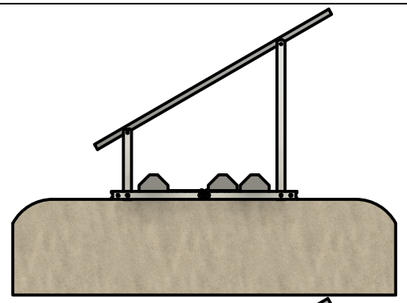
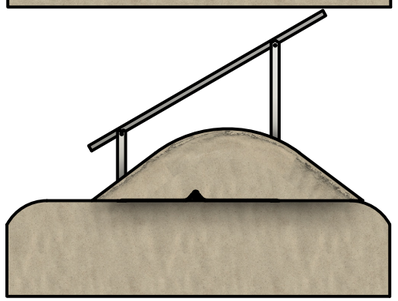
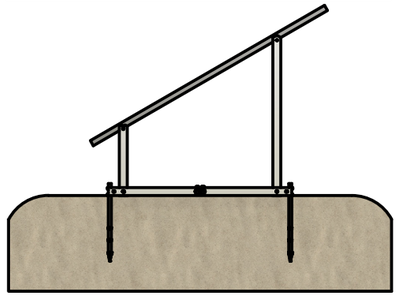


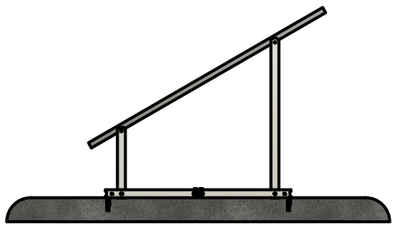
Base Frame Ballasted:
Three 175lb curb stop ballasts per solar module.
525lbs minimum per solar module for
70-80 mph windspeed. (No stakes required)



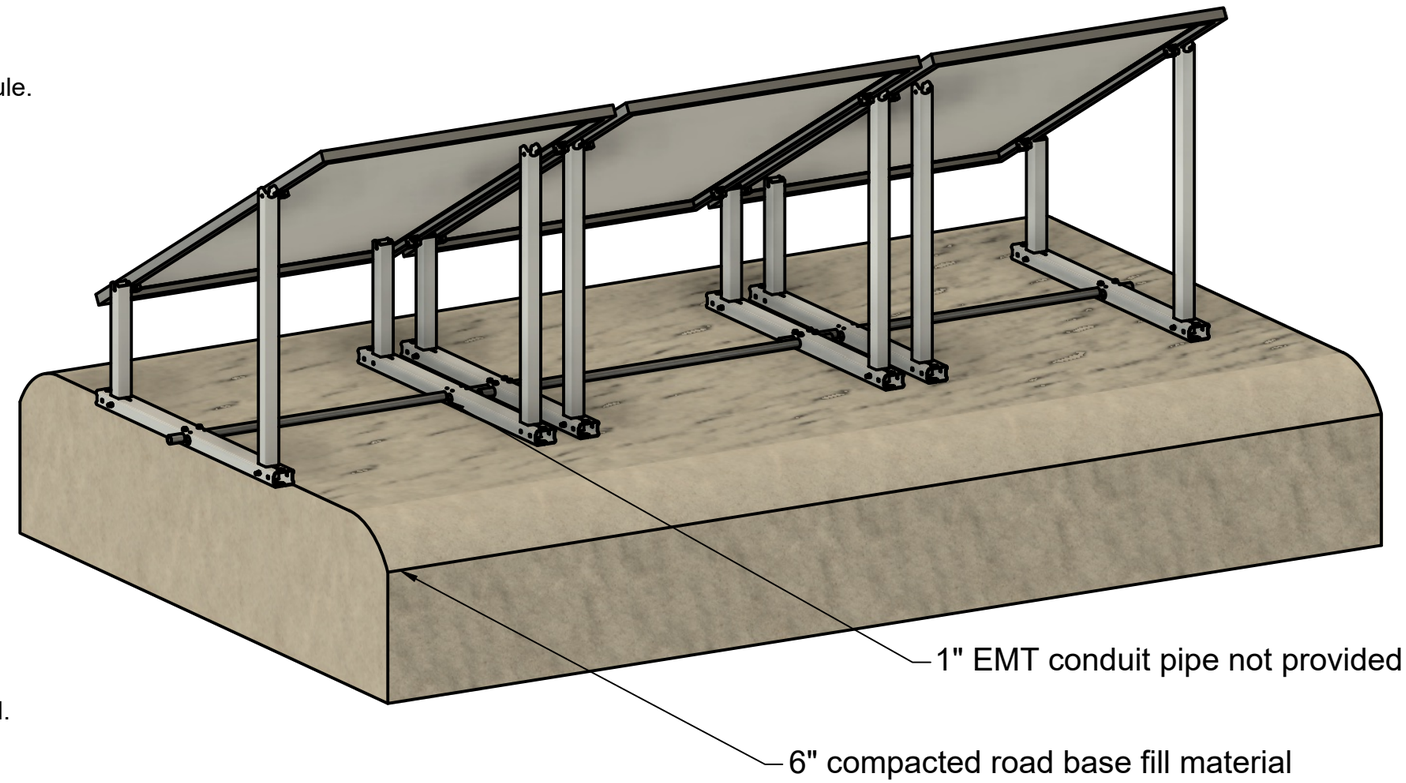
IR EarthBallast™ System:
18in fill to top of mound. 1000lbs
minimum per solar module.
Center of mound 6" offset toward rear leg.
(3/4x12" Steel concrete forming stakes
required at each end of base tube member)



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 24 inches.)



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

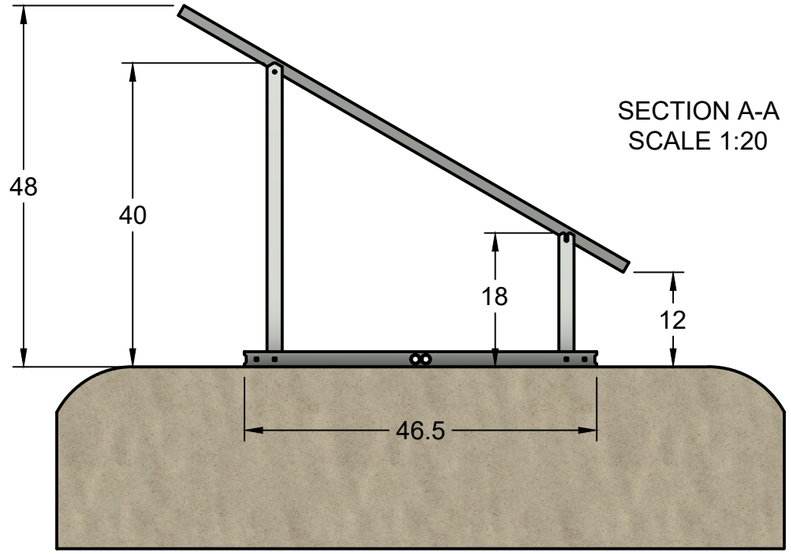


	PROJECT: IntegraRack				
	TITLE: IR-30 Solar Racking System Data Sheet IR-30RF1000				
APPROVED Paul Budge 3/29/2024	SIZE B	CODE	DWG NO 1010		REV
CHECKED Paul Budge 3/29/2024					
DRAWN Jeff Glauser 3/29/2024	SCALE 1:25	WEIGHT 9.5lbs/frame section		SHEET 1/2	

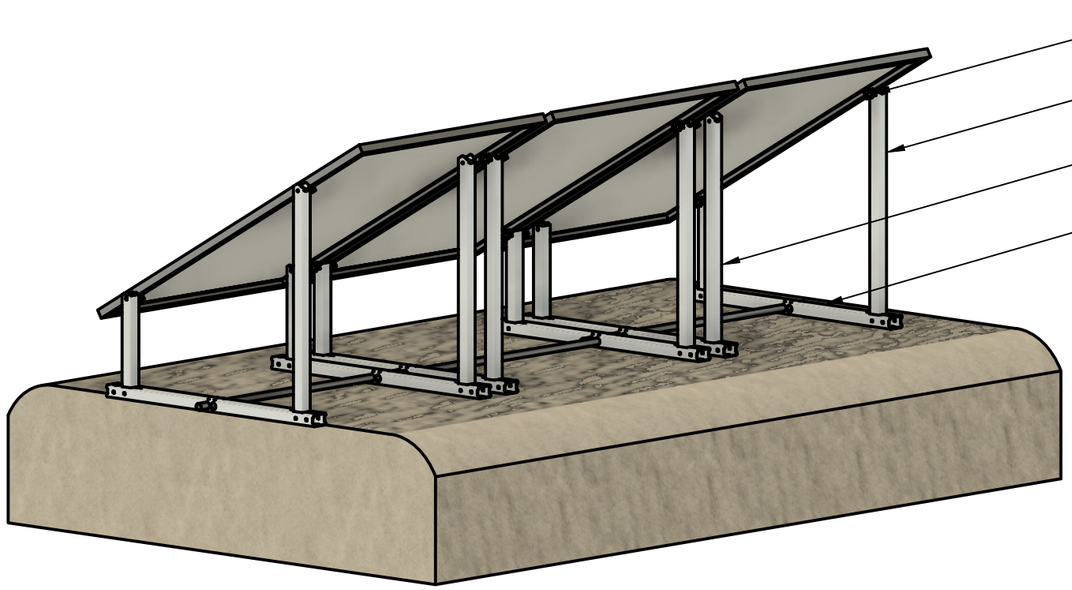
IR-30 Solar Racking System		
	Module size up to 24 sqft	**Module size up to 34 sqft**
Maximum Snow Load		
	100psf	65psf
Maximum Wind Speed		
Base Frame Ballasted	80mph	70mph
IR EarthBallast™	120mph	100mph
IR AnchorSpike™	120mph	100mph
Base Frame Bolted	150mph	120mph

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

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



SECTION A-A
SCALE 1:20



Parts List	
1	IR-F2FC0002
2	IRP-30LL1000-T
3	IRP-00SL1000-T
4	IRP-00BT1000-T

PROJECT
IntegraRack

TITLE
IR-30 Solar Racking System
Data Sheet
IR-30RF1000

APPROVED		SIZE	CODE	DWG NO	REV
CHECKED		B		1010	
DRAWN	Jeff Glauser 3/29/2024	SCALE 1:20	WEIGHT 9.5lbs/frame section	SHEET 2/2	

PNL
An ALS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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. 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
Phoenix National Laboratories
Ph: 1.602.431.8887
kyle@pnltest.com
www.pnltest.com

PNL
An ATS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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

PNL
An ATS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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

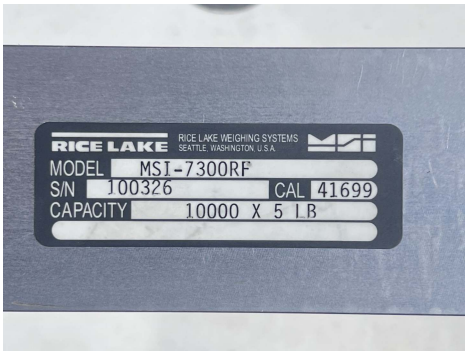


PHOTO 2: Dynamometer ID label

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

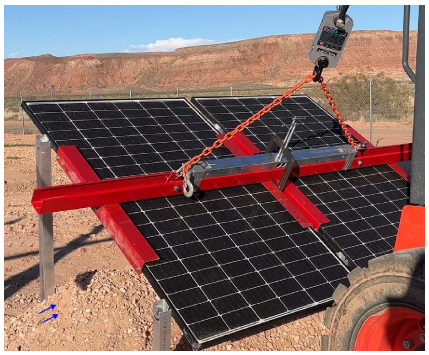


PHOTO 8: Test 2 - Evidence of ballast shift

PHOTO 9: Test 2 - Evidence of ballast shift

An ATS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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

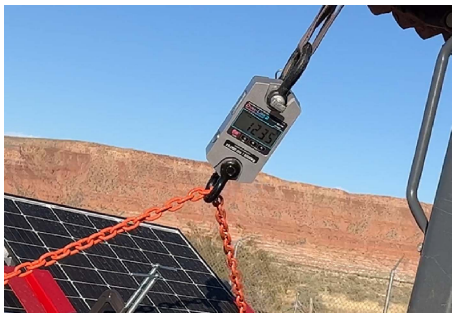


PHOTO 12: Test 2 - Max load

PHOTO 13: Ballast after completion of testing

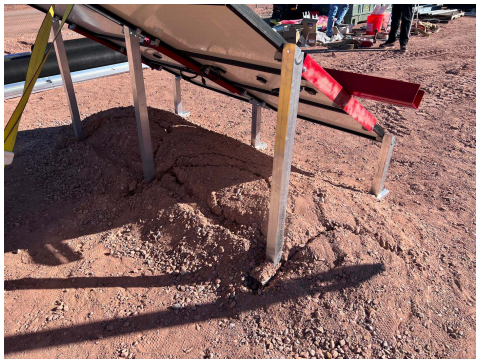


PHOTO 14: Ballast and frame after completion of testing

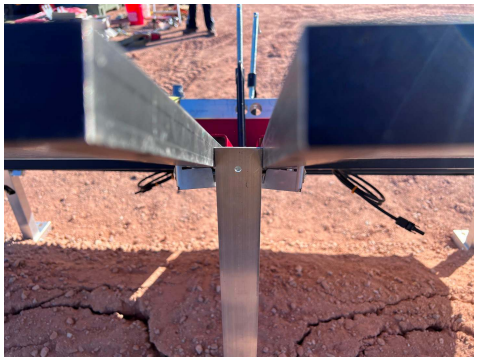


PHOTO 13: IR-F2 Clamp bracket after completion of testing

PNL
An ATS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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 

An ATS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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

PNL
An ETS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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.

TECHNICIAN 

REVIEWED BY 

PNL
An ETS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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 - 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

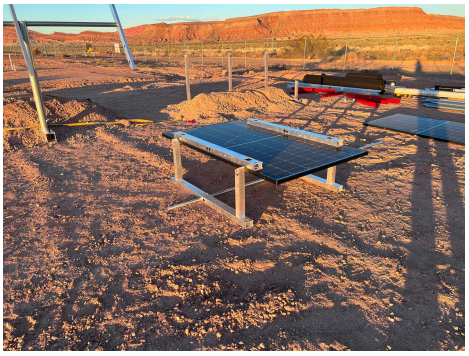


PHOTO 3: IR-30 Solar Racking System setup for test

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

PNL
An ATS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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 - 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

PNL
An ATS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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. 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)

TECHNICIAN 

REVIEWED BY 

PNL
An ATS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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.

PHOTOS

PHOTO 1: Dynamometer used to record loads

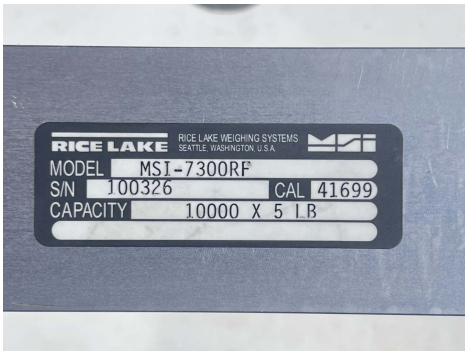


PHOTO 2: Dynamometer ID label

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

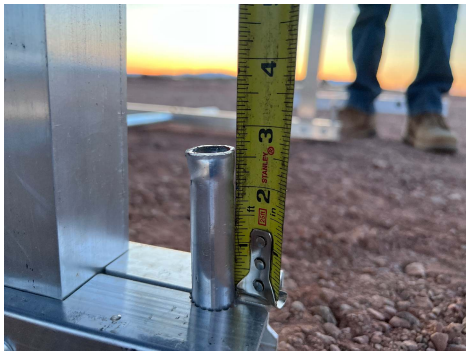


PHOTO 4: 'Stickout' measurement example at Spike #3

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

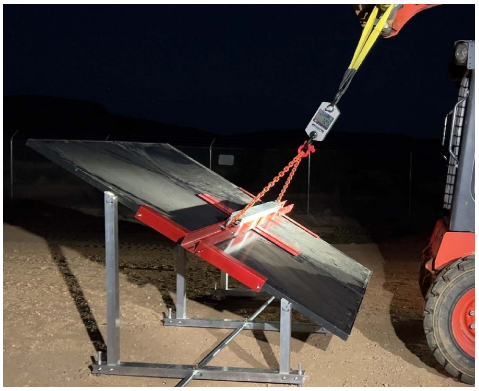


PHOTO 6: Test setup - IR-30 Solar Racking System with AnchorSpikes

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

PNL
An ATS Company
Phoenix National Laboratories, LLC
941 S. Park Lane, Tempe, AZ 85281
P: 602.431.8887 • www.pnltest.com

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.

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