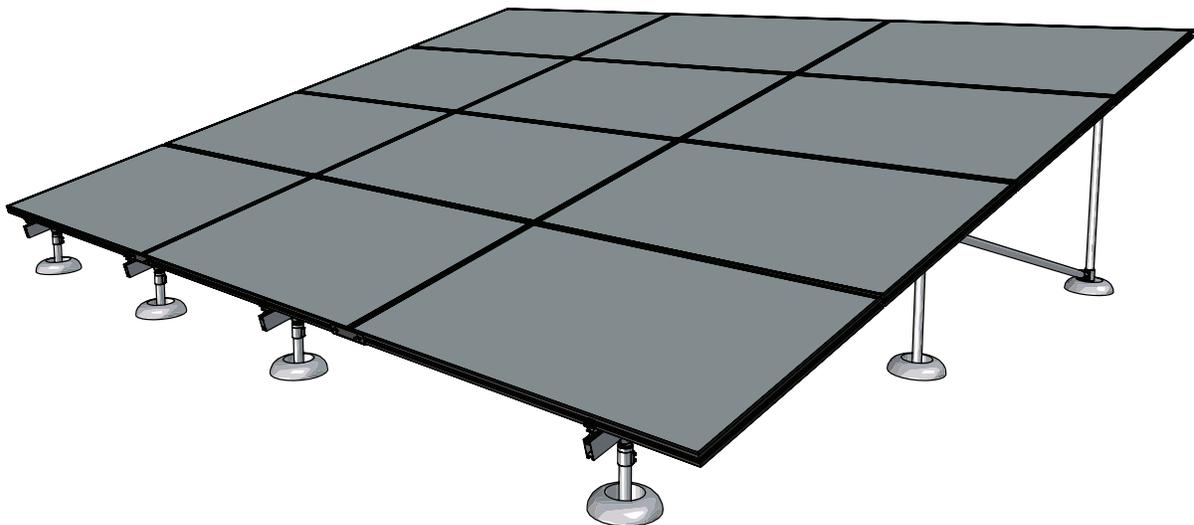




ZS Ramp

for residential low-slope roofs

Installation Instructions



Notices

This manual contains safety, installation, configuration and troubleshooting instructions for Zep Solar products. Zep Solar recommends that you save this manual in a readily accessible location, should any questions arise.

ZS Ramp is UL 2703 Listed for Bonding.

ZS Ramp has a UL 1703 Class "A" Fire Rating when installed on low slope roofs using modules from any manufacturer certified as "Type 1" or "Type 2."

ZS Ramp is to be mounted over a fire resistant roof covering rated for the application.

This system should be periodically re-inspected by qualified service technicians. In the event any components or fasteners are found to be loose, they should be re-tightened to manufacturer's specifications. Any components showing signs of corrosion that compromise safety or function shall be replaced immediately.

ZS Ramp may only be used to ground and mount Zep-compatible PV modules.

All Zep-compatible modules comply with UL 1703 and have been evaluated for grounding and mounting in compliance with the included instructions. Zep-compatible modules are identified by the Zep logo on their label.

Contents

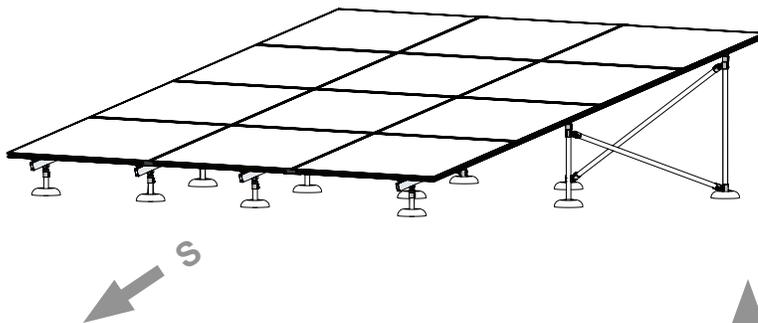
Notices	2
Introduction	4
ZS Ramp Tube Assembly	5
Core Components	6
Additional Components	8
Recommended Tools	9
The Zep Compatible Platform	10
Installation Steps	11
Step 1. Layout and Preparation	11
Step 2. Install Base Feet	12
Step 3. Install MTs	13
Step 4. Install Tube Assemblies	16
Step 5. Install North-South Cross Bracing (as needed)	19
Step 6. Install East-West Cross Bracing	21
Step 7. Install Cam Feet	23
Step 8. Option A: 2-Point Drop-In	25
Step 9. Option B: 1-Point Drop-In	27
Step 9. Complete First Row of Modules	30
Step 10. Complete Remaining Modules	32
Step 11. Install Sealant Tub	33
Step 12. Ground the Array	34
Grounding and Inter-Array Bonding	35
Wire Management Recommendations	36
Important Safety Precautions	37
Module Servicing	38

Introduction

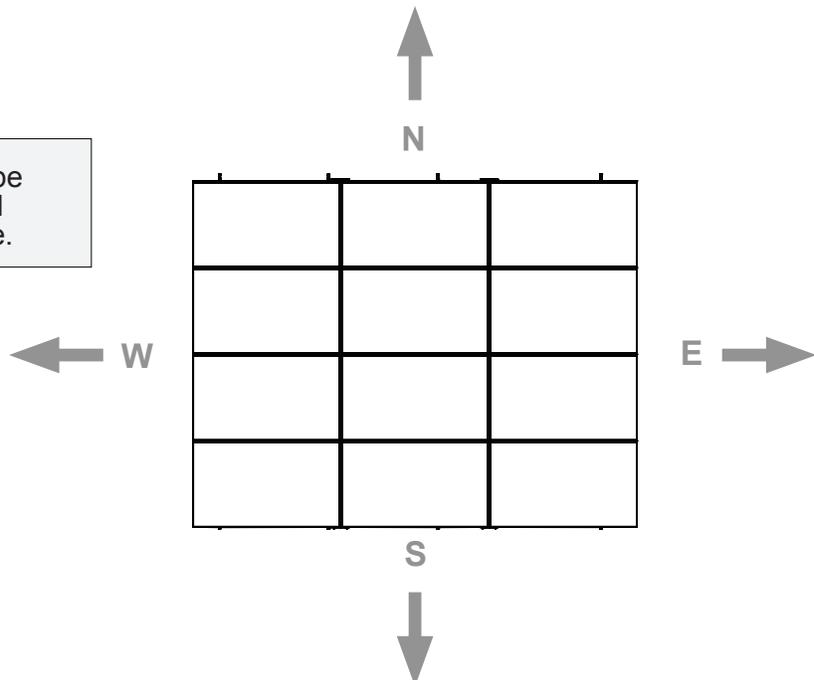
This document describes basic installation procedures for ZS Ramp, Zep Solar’s PV mounting system for residential low-slope roofs.

System Features: The ZS Ramp auto-bonding PV mounting solution uses a self-templating, South-facing assembly. A low system profile allows for greater power density. Designed for ease and speed of installation, ZS Ramp works with all Zep Compatible PV modules.

Roof Requirements: ZS Ramp is installable on most commonly used residential low-pitch roof types with a pitch of 7 degrees or less, and a maximum total change in slope of 5 degrees.

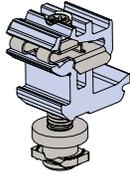


i Assembly diagrams will be oriented using directional arrows as illustrated here.

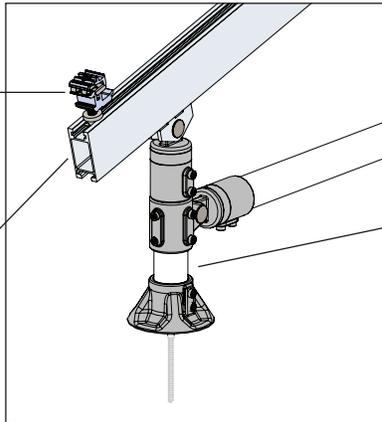


ZS Ramp Tube Assembly

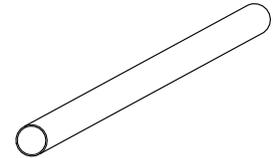
Cam Foot V2



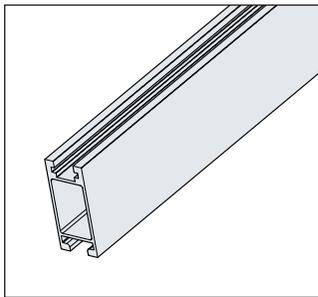
Tube Assembly - Installed



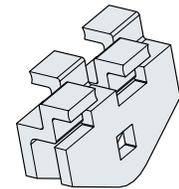
Mechanical Tubing
1 1/4" (MT)



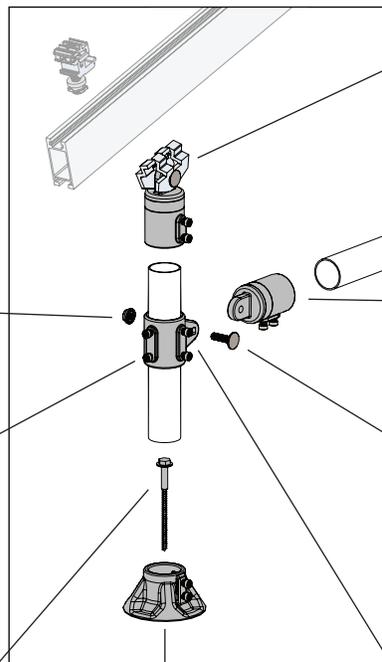
Rail



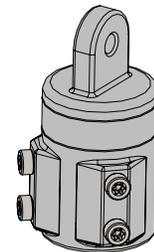
Bracket Clamps



Tube Assembly - Exploded



Tube Head



Flange Nut M8



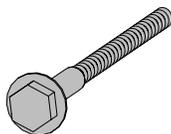
Carriage Bolt M8



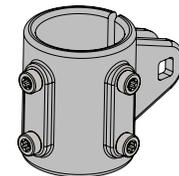
Torx head Set Screw M8



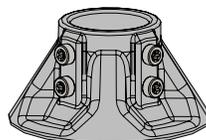
5/16" Lag Bolt with
Captive Washer



Cross Brace Bracket

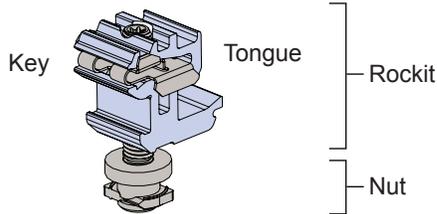


Base Foot



Core Components

Cam Foot V2



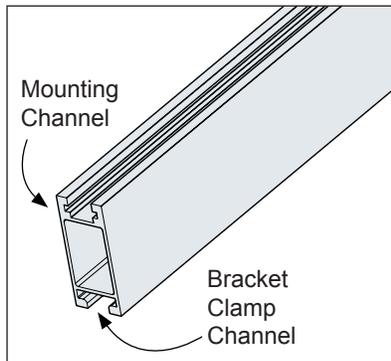
Cam Foot V2

Part No. 850-1564

Listed by UL to UL 2703

Secures PV Modules to the Rail, and enables fine-tuned leveling. Creates an electrical bond between modules on both Key and Tongue sides. Also creates bond with Rail.

Rail



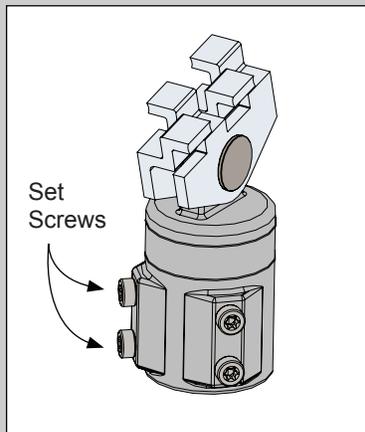
Rail (Varying lengths)

Listed by UL to UL 2703

- 5100mm - Part No. 850-1569**
- 4100mm - Part No. 850-1568**
- 3100mm - Part No. 850-1567**
- 2100mm - Part No. 850-1566**
- 1100mm - Part No. 850-1565**

Attaches to Bracket Clamp to provide a mounting channel for the Cam Feet.

Post Mount

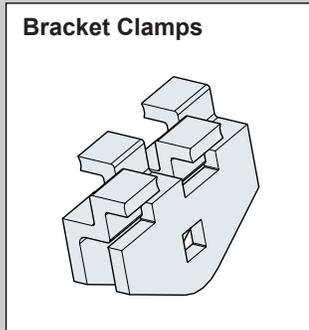


Post Mount
Part No. 850-1561

Listed by UL to UL 2703

Comes pre-assembled with a toothpick for convenient Rail installability.

Bracket Clamps

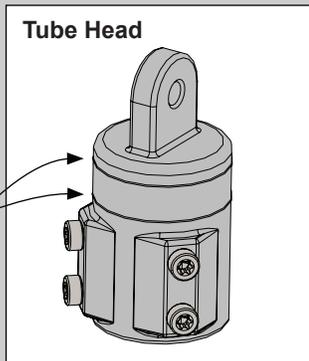


Bracket Clamps

Attaches to Rail and Tube Head and acts as an adjustable pivot point for variable rail mounting angles.

Comes pre-assembled with Tube Head as Post Mount.

Tube Head



Tube Head

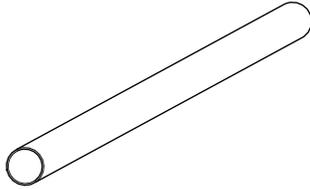
Attaches to Bracket Clamps and MT (Mechanical Tubing).

Features 1/2" Timing Marks for MT cutting and fitting.

Comes pre-assembled with Bracket Clamps as Post Mount.

Core Components, Continued

Mechanical Tubing (MT)



Mechanical Tubing (MT)

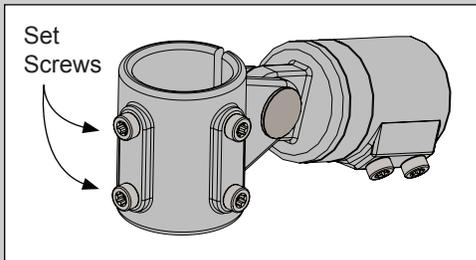
Part No. 850-1583

Listed by UL to UL 2703

1.51" Outer Diameter

Joins Tube Head, Cross Brace Bracket, and Base Foot to provide a variable-length Tube Assembly.

Cross Brace Kit



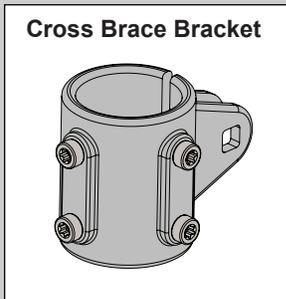
Cross Brace Kit

Part No. 850-1562

Listed by UL to UL 2703

Attaches to MT to act as an adjustable pivot point for variable cross brace mounting angles.

Cross Brace Bracket

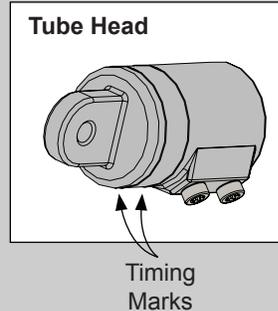


Cross Brace Bracket

Attaches to MT and Tube Head to provide structural bracing for assembly.

Comes pre-assembled with Tube Head as Cross Brace Kit.

Tube Head



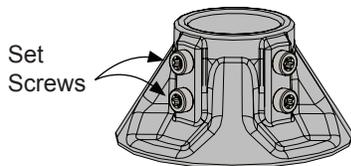
Tube Head

Attaches to Cross Brace Bracket and MT.

Features 1/2" Timing Marks for MT cutting and fitting.

Comes pre-assembled with Cross Brace Bracket as Cross Brace Kit.

Base Foot



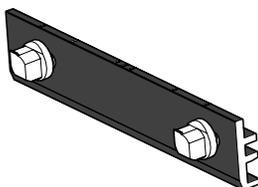
Base Foot

Part No. 850-1563

Listed by UL to UL 2703

Attaches to MT and rafter to secure the assembly onto the roof.

Interlock



Interlock

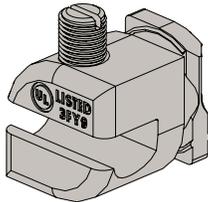
Part No. 850-1388

Listed by UL to UL 2703

Provides a structural and electrical bond between modules.

Additional Components

Ground Zep V2

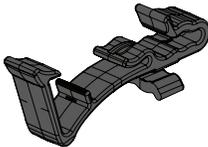


Ground Zep V2

Part No. 850-1511

Provides a single point for grounding the PV array. Listed by UL to UL 467 and UL 2703.

DC Wire Clip

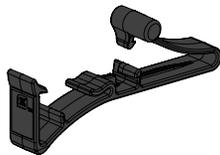


DC Wire Clip

Part No. 850-1448

Snaps into the Zep Groove to secure array wiring and adjust wire tension, with parallel and 90 degree clips. Fits wires 5.2mm-7.6mm in diameter. Listed by UL to UL 1565 as a Wire Positioning Device.

Home Run Wire Clip



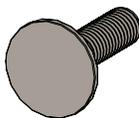
Home Run Clip

Part No. 850-1510

Secures up to 5 conductors underneath a Zep Compatible PV array, providing quick and secure routing of conductors to the termination location. Listed by UL to UL 1565 as a Wire Positioning Device.

Carriage Bolt M8

Torque value: 16 ft-lbs



Flange Nut M8



Sealant and Sealant Tub

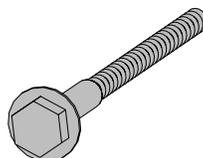


Torx head Set Screw M8

Torque value: 110 inch-lbs

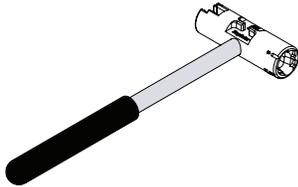


5/16" Lag Bolt

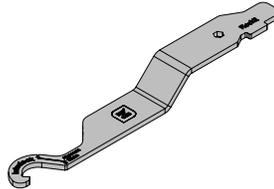


Recommended Tools

Zep Tool



Offset Flat Tool



Band Saw



String Line



Line Level



Measuring Tape



Spirit Level



Protractor



Drill / Impact Driver



T30 Torx Bit



3/16" Drill Bit



13mm" Socket



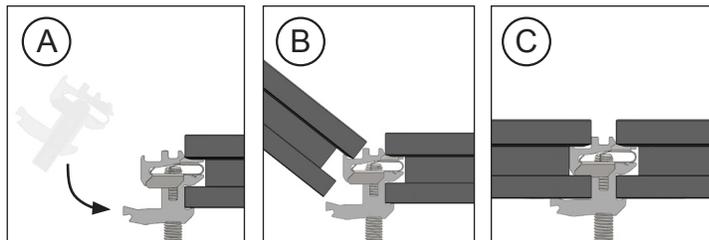
The Zep Compatible Platform

Zep Solar mounting solutions are based on the Zep Groove, a patented module frame profile designed to mate easily and precisely with Zep Solar components.



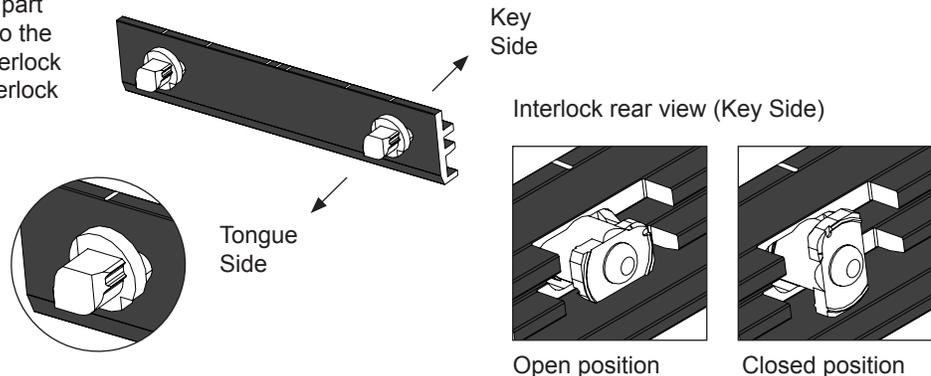
In ZS Ramp, the Key side of the Cam Foot inserts into the Zep Groove, securing the module in place. The locking process is auto-bonding.

i The insertion side is called the Key side.



The Key side of the Cam Foot Rockit inserts into Zep Groove, while the Tongue side receives a module that is placed on edge and then rotated downwards.

The Interlock has a movable part called a "Zep" that rotates into the Zep Groove, securing the Interlock to the module frame. The Interlock is used to connect modules together at the corners.



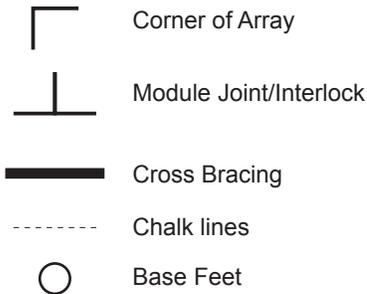
Installation Steps

Step 1. Layout and Preparation

Compare projected rafter locations on the project plan set with actual rafter locations; ensure that the layout is accurate. Create a chalk layout on roof according to the project plan set, then mark the locations of Base Feet.

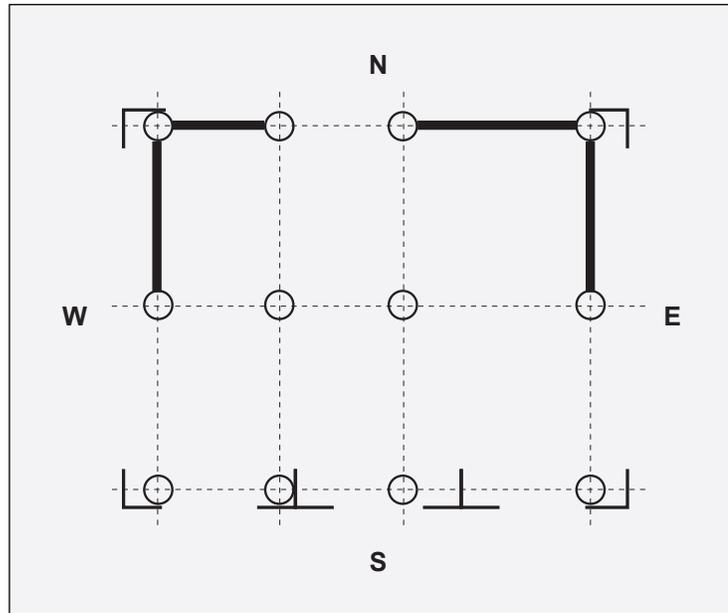
Refer to the project plan set for Engineering Rules regarding:

- Maximum Spacing
- Cantilever
- Fire Setback



Verify rafter locations to ensure that the layout is well suited for the roof.

Example Project Plan Set



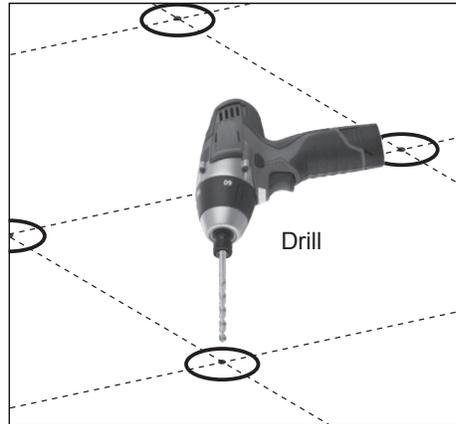
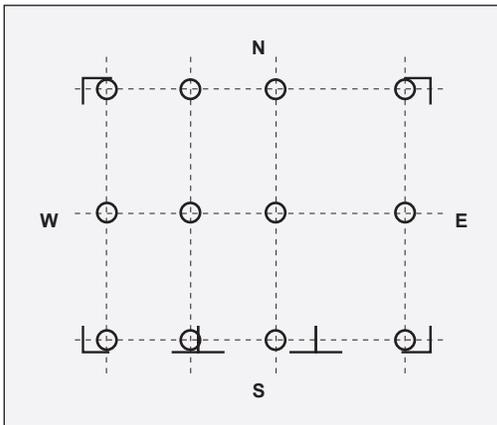
Maximum span, cantilever, and cross bracing locations are project-specific values that depend on factors such as wind zone, snow load, and neighborhood topography. **Check the project plan set for these values.**

If project-specific values are not available, you can refer to these system-wide rules that apply to all ZS Ramp systems regardless of project conditions.

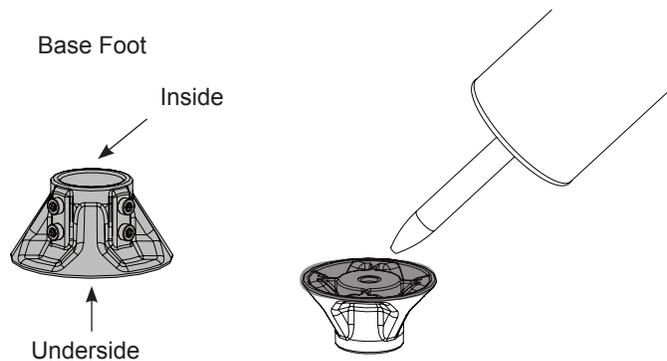
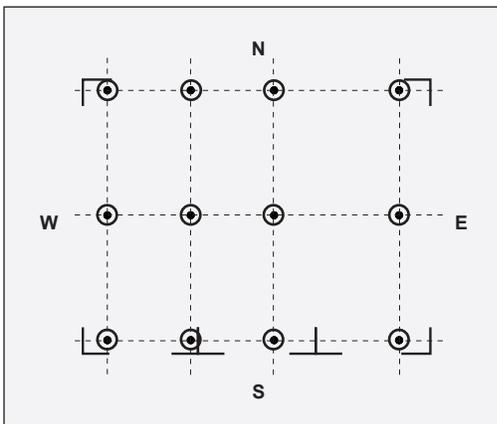
- Tilt range is 0-15 degrees.
- The system can be installed in either Landscape or Portrait orientations.
- Spans can never exceed 72 inches in the East-West direction, or 48 inches in the North-South direction.
- Module or rail cantilever can never exceed 24 inches.
- Cam Foot minimum distance from a module corner is 2 inches, measured from the center of the Cam Foot threaded stud.
- Thermal expansion required every 10 meters, or appx. 33 feet.
- When required, North-South Cross Bracing will ALWAYS span the shortest and outermost Tube Assemblies.
- When required, East-West Cross Bracing will ALWAYS span the backmost and outermost Tube Assemblies.
- Cross bracing will occur between 5 and 15 degrees.

Step 2. Install Base Feet

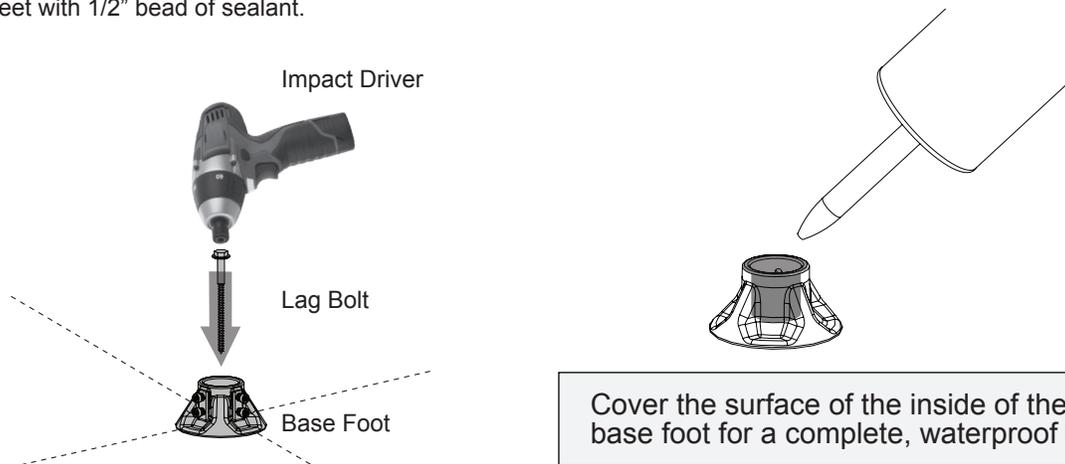
(A) Drill pilot holes at the marked locations of the Base Feet.



(B) Cover the surface of the underside of the Base Feet with a 1/2" bead of sealant.

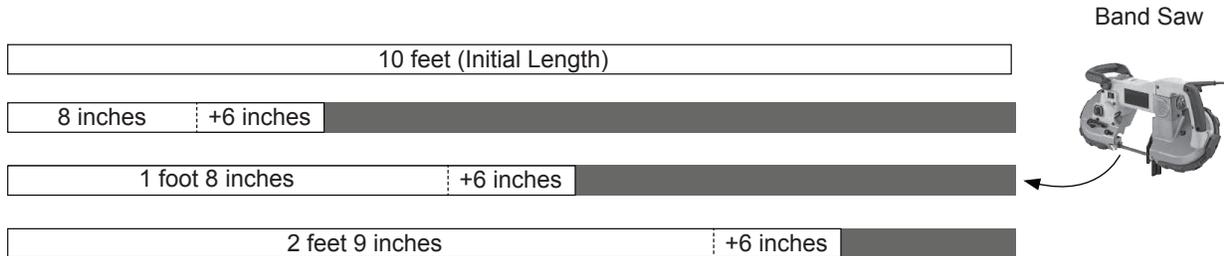


(C) Place the Base Feet at the marked locations and secure in place with a Lag Bolt. Cover the inside of the Base Feet with 1/2" bead of sealant.



Install Base Feet, Continued

- (D) While the Base Feet are being installed, cut MTs to the heights specified in the project plan set, plus 6 inches.

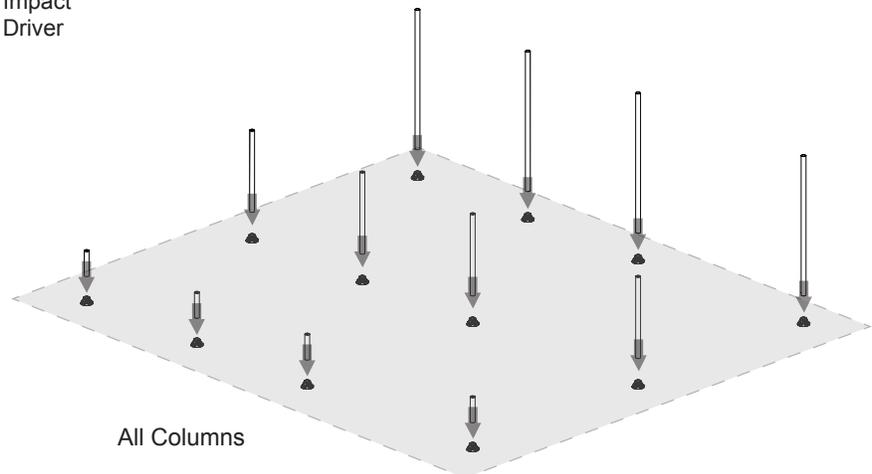
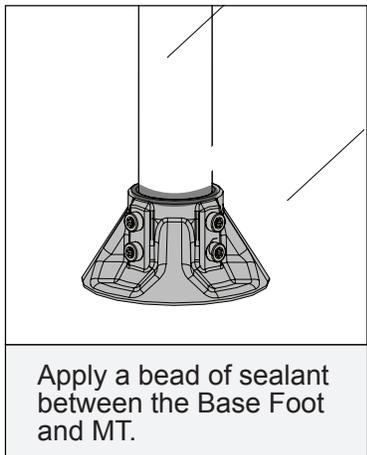
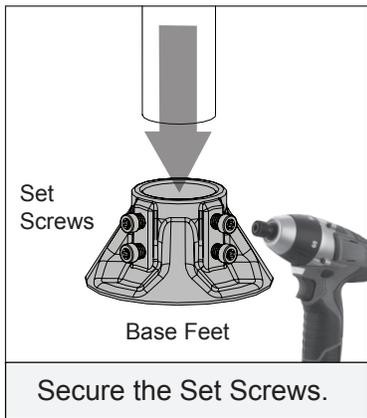


In this instance we will use 8 inches, 1 foot 8 inches, and 2 feet 9 inches as our standard MT measurements.

Cut MTs to specified heights plus 6".

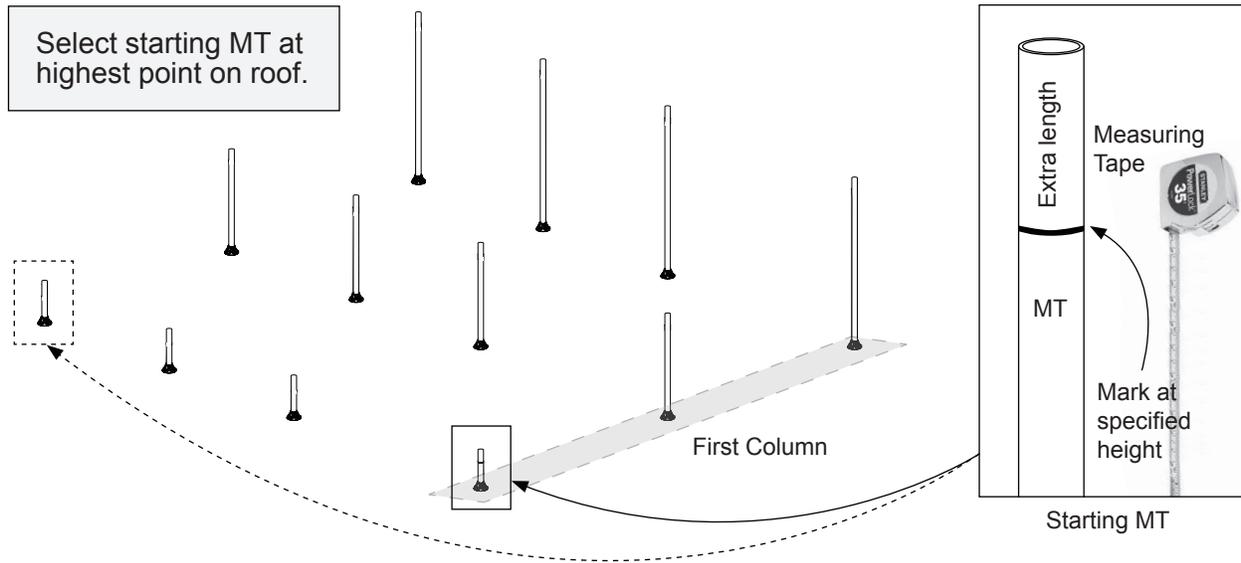
Step 3. Install MTs

- (A) Insert MTs into the Base Feet and fully secure the Base Feet Set Screws. Apply a bead of sealant between each Base Foot and MT.



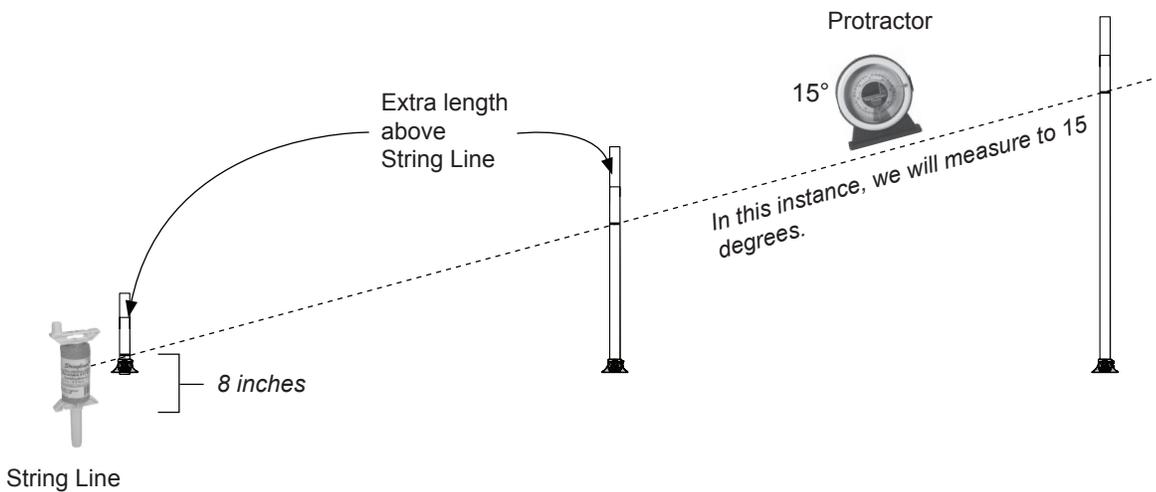
Install MTs, Continued

- (B) Select the starting MT as the shortest MT at the highest point on the roof. Use a Measuring Tape to measure out the height specified in project plan set.



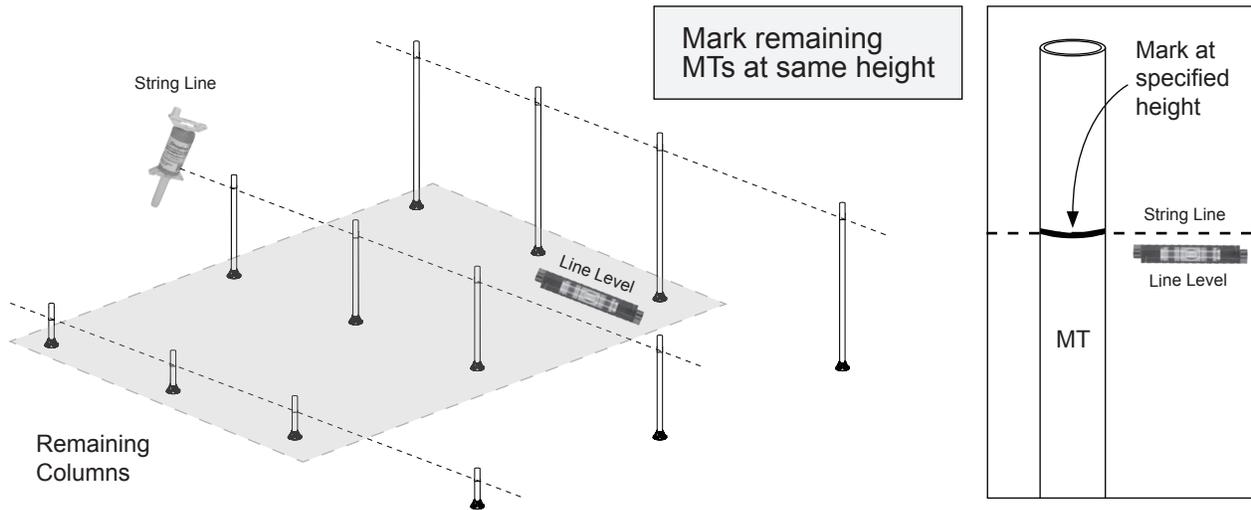
In this instance we will begin on the South-East corner.

- (C) Use a String Line and Protractor to measure the slope of the first column according to the slope specified in the project plan set, then mark the MTs.

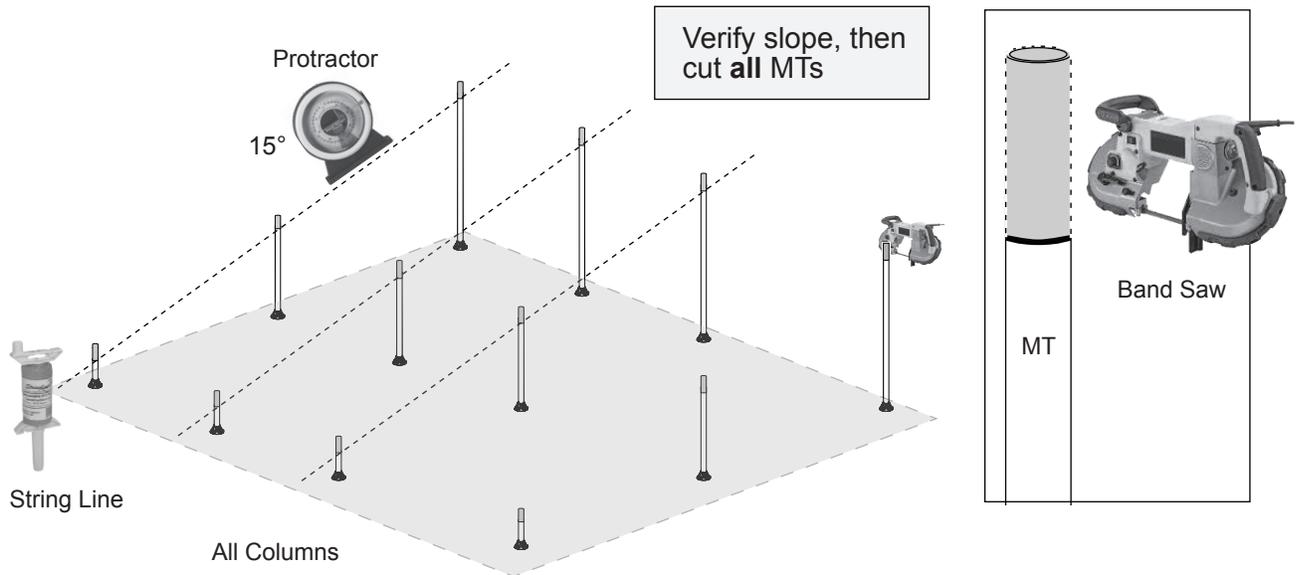


Install MTs, Continued

D Use a String Line and Line Level to mark remaining columns of MTs at same height.

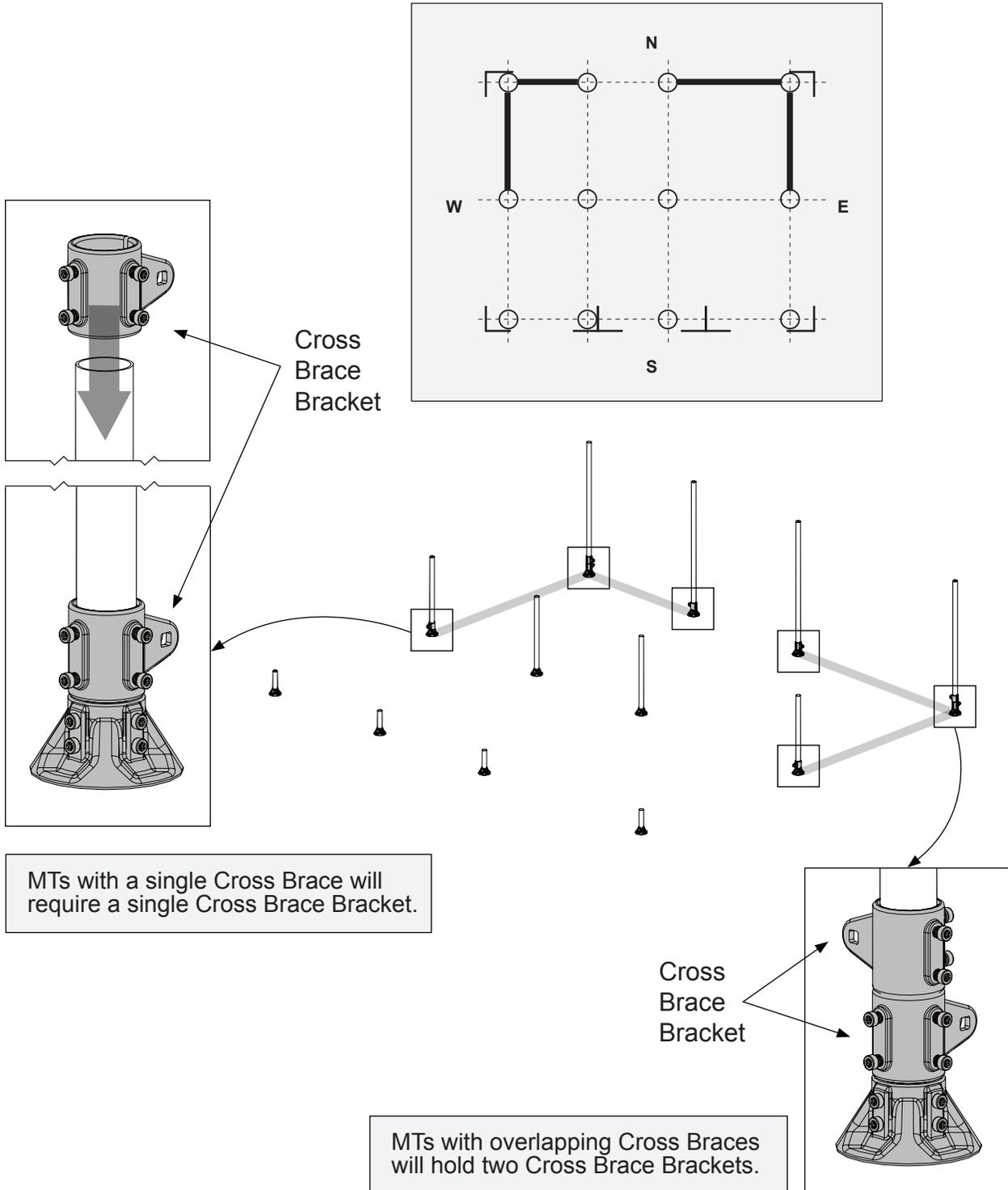


E Use a Protractor to verify the slope of the remaining columns, then cut all MTs.



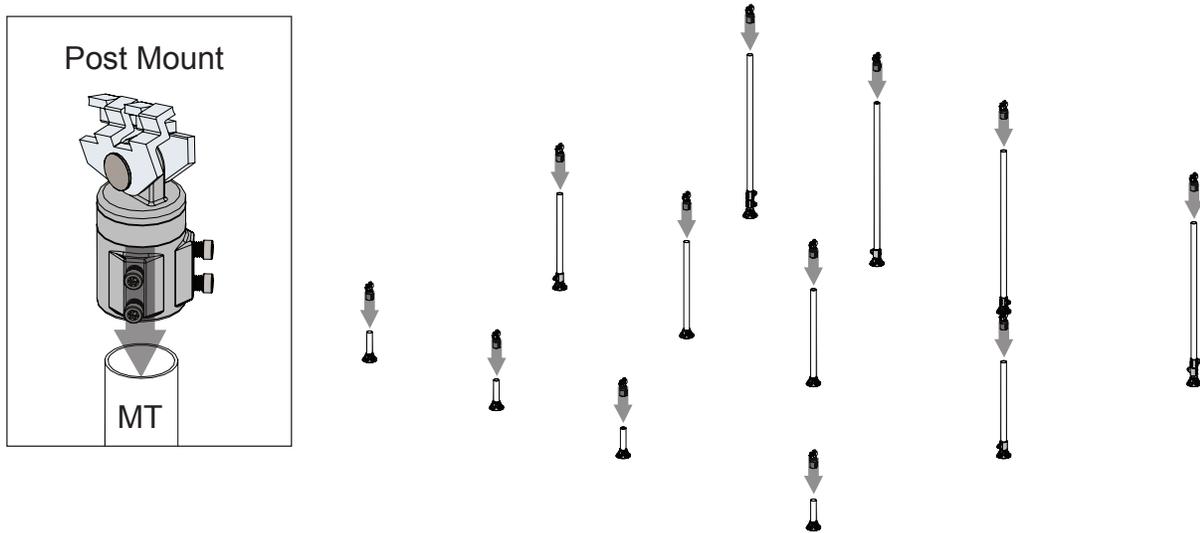
Step 4. Install Tube Assemblies

(A) Install Cross Brace Brackets on MTs according to the project plan set.

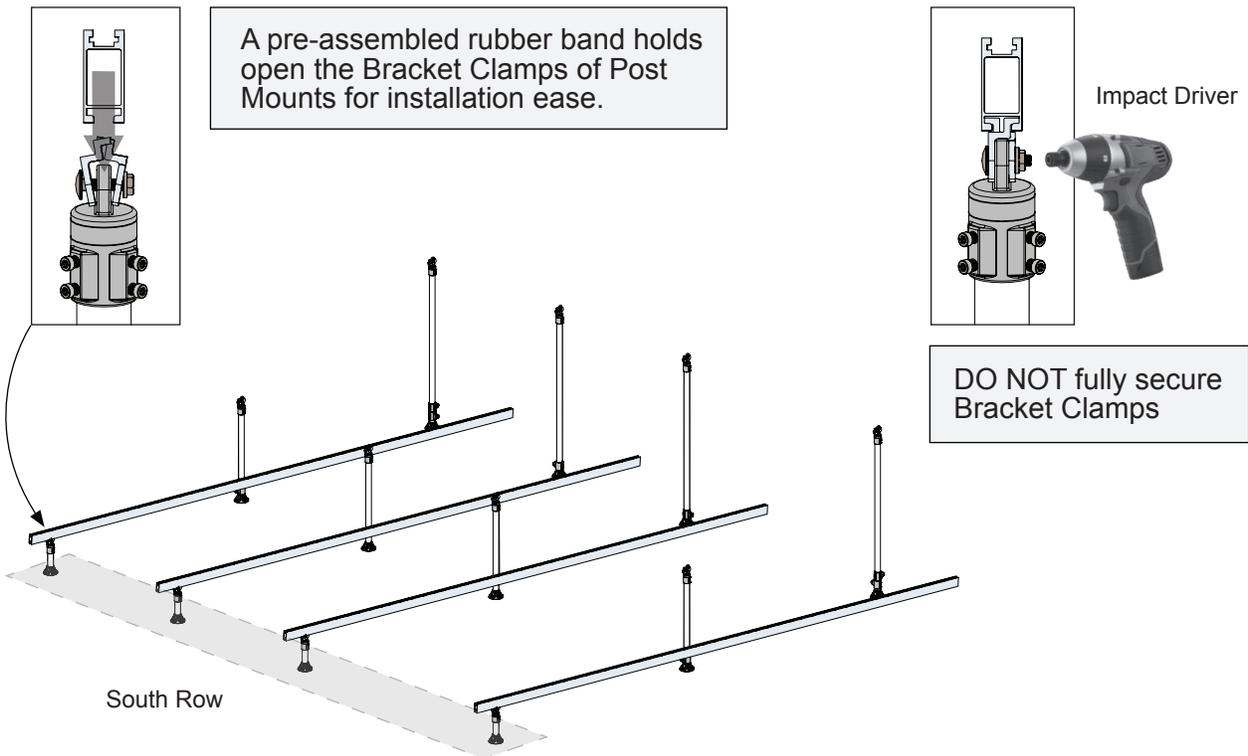


Install Tube Assemblies, Continued

(B) WITHOUT FULLY SECURING THE FASTENERS, install Post Mounts on all MTs.

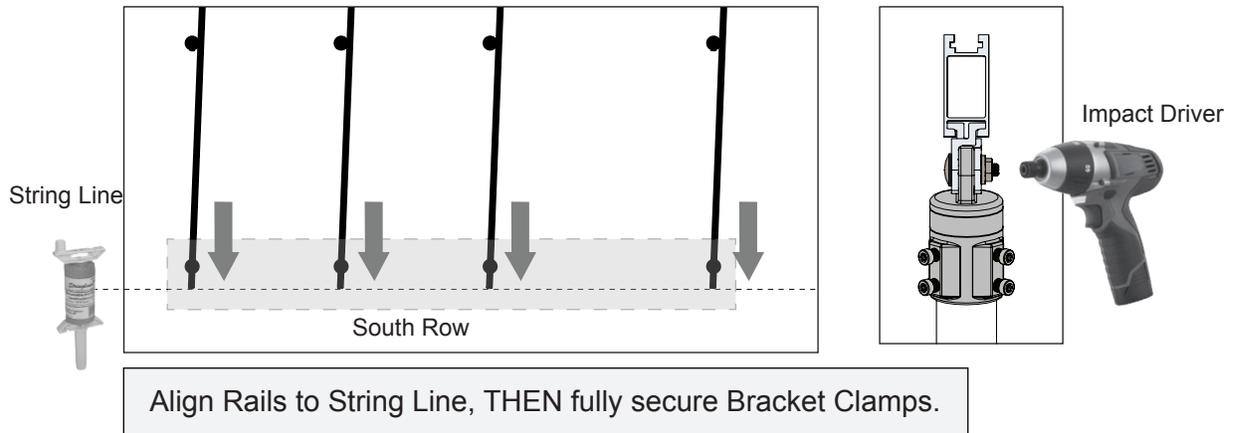


(C) WITHOUT FULLY SECURING THE BRACKET CLAMPS, install Rails onto the South row of Post Mounts.

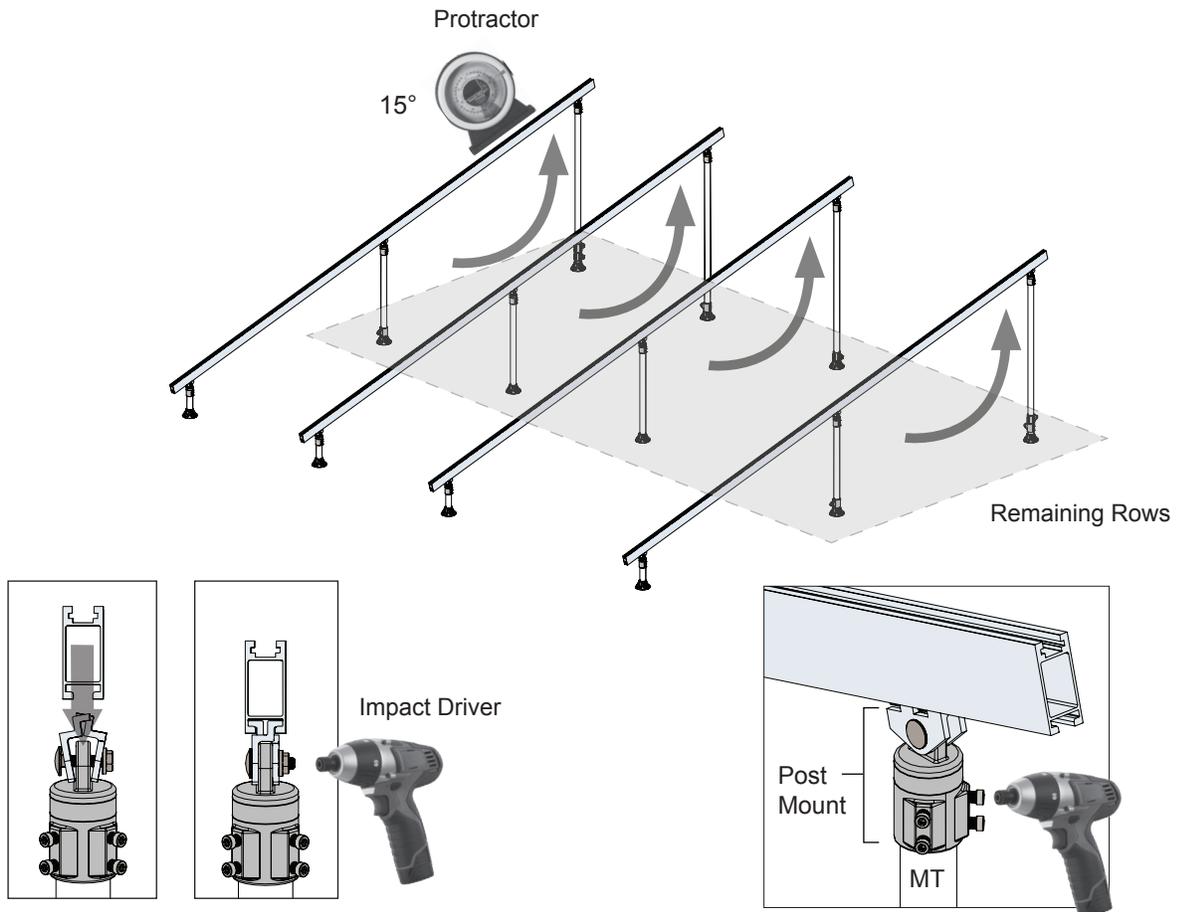


Install Tube Assemblies, Continued

- (D) Use a String Line to align the Rails, THEN fully secure the South row of Bracket Clamps.

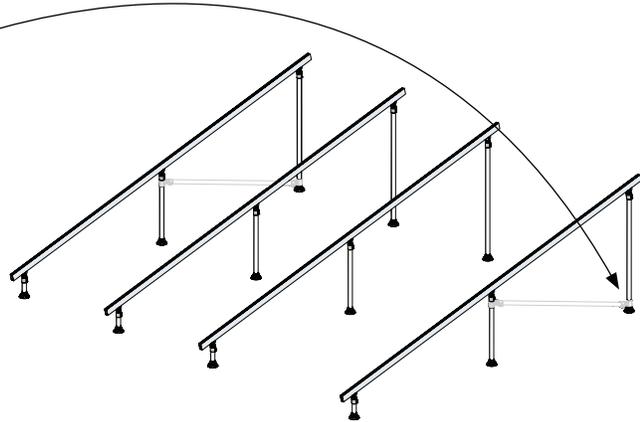
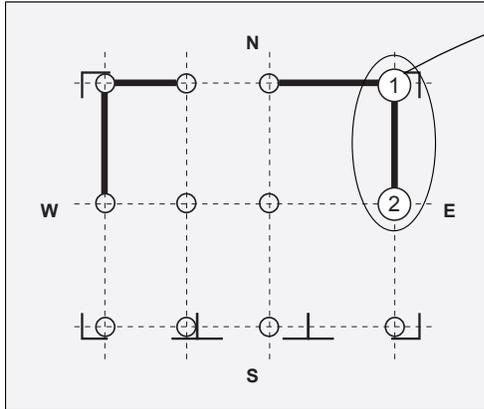


- (E) Install the Rails along the remaining rows of Bracket Clamps, adjusting the Post Mount heights as needed to achieve the slope specified in the project plan set. Fully secure ALL Bracket Clamp and Post Mount fasteners.



Step 5. Install North-South Cross Bracing (as needed)

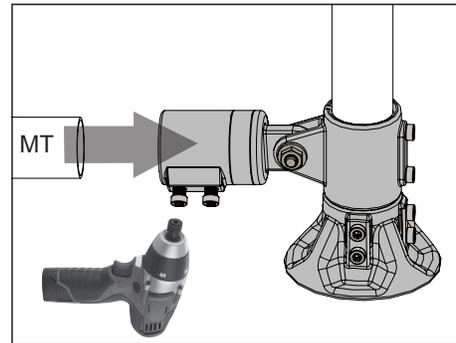
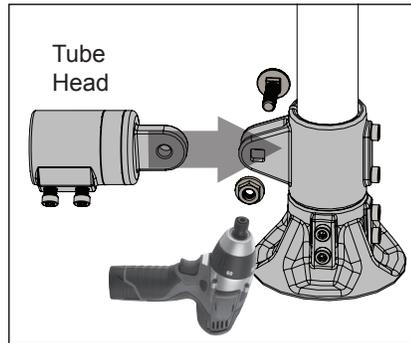
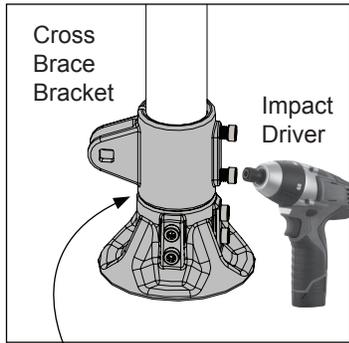
- (A) Refer to the project plan set for guidance on where to install North-South Cross Bracings.



In this instance, we will begin on the North-East corner.

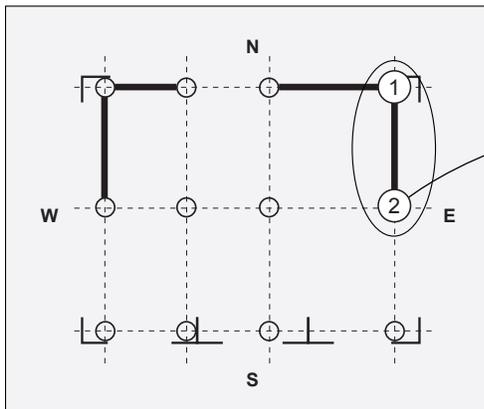
Example installation of North-South Cross Braces

- (B) Fully secure the first Cross Brace Bracket on the North-end **directly above the Base Foot**. Install a Tube Head onto a Cross Brace Bracket, then install an MT onto the Cross Brace Bracket. Fully secure all fasteners.

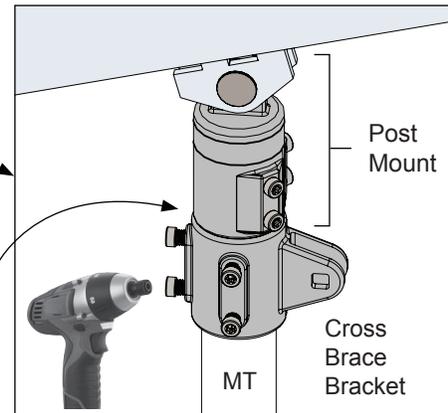


First Cross Brace Bracket should touch top of Base Foot.

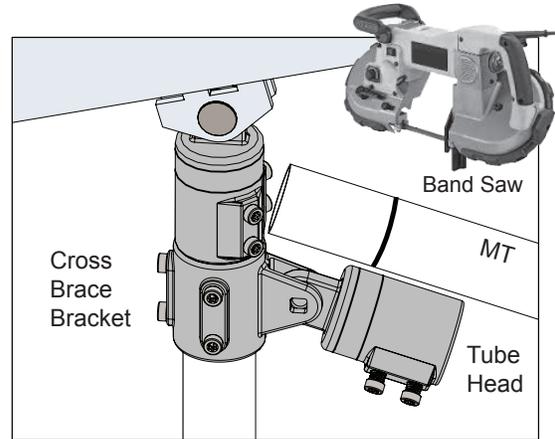
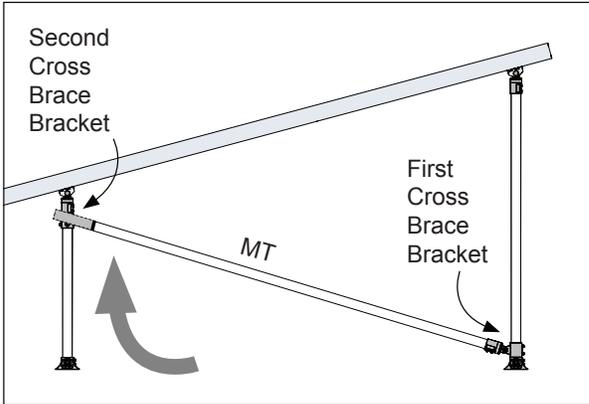
- (C) Fully secure the second Cross Brace Bracket directly under the Post Mount.



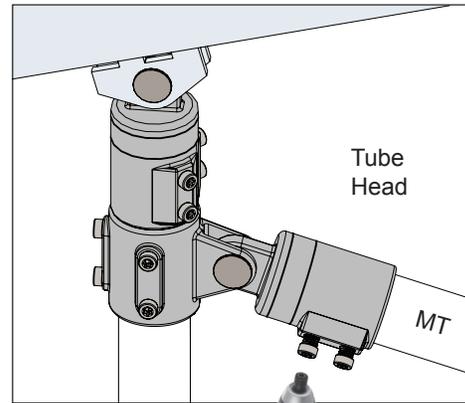
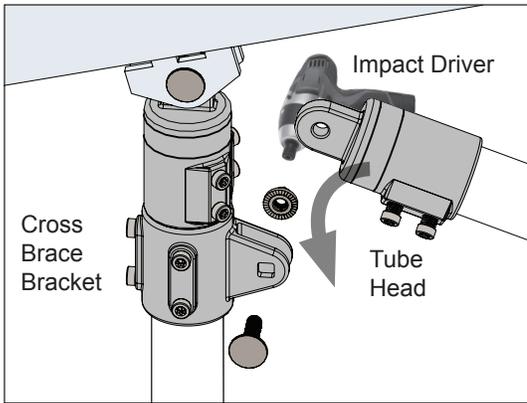
Second Cross Brace Bracket should touch bottom of Post Mount.



- D Raise the MT up to the second Cross Brace Bracket. Hold a Tube Head up to Cross Brace Bracket, then mark MT to length between Tube Head timing marks. Cut MT.



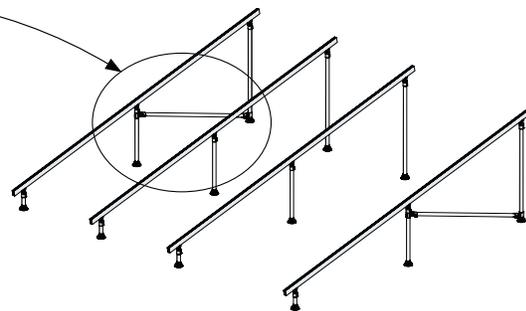
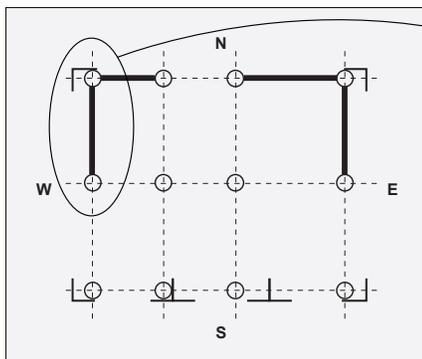
- E Fit Tube Head onto the MT to ensure proper fit, adjusting or modifying the MT as needed. Once verified, fully secure all fasteners.



FIRST, secure the Tube Head onto the Cross Brace Bracket.
THEN secure the Tube Head onto the MT.

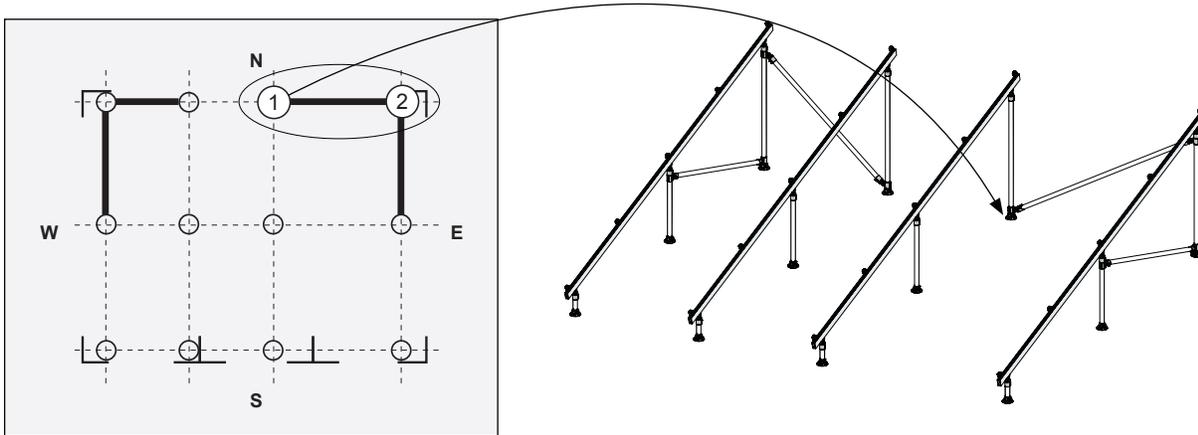


- F Install a North-South Cross Bracing on the remaining side.



Step 6. Install East-West Cross Bracing

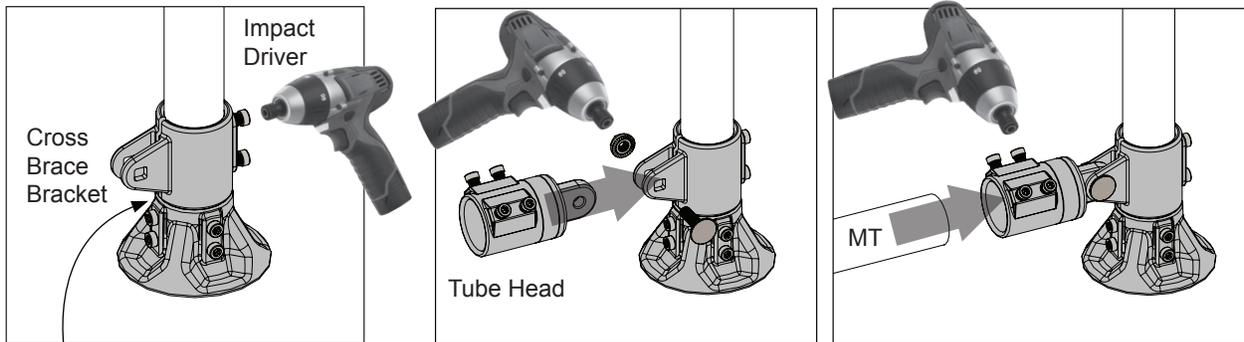
- (A)** Refer to the project plan set for guidance on where to install East-West Cross Bracings. Fully secure the first Cross Brace Bracket **directly above the Base Foot**.



In this instance, we will begin on the East inner MT.

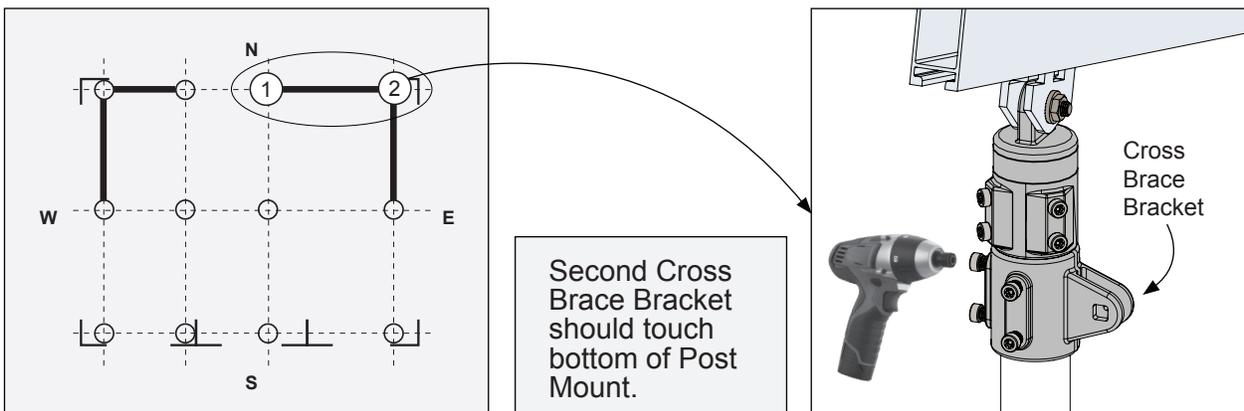
Example installation of East-West Cross Braces

- (B)** Install a Tube Head onto an inner Cross Brace Bracket, then install an MT onto the Tube Head.



First Cross Brace Bracket should touch top of Base Foot.

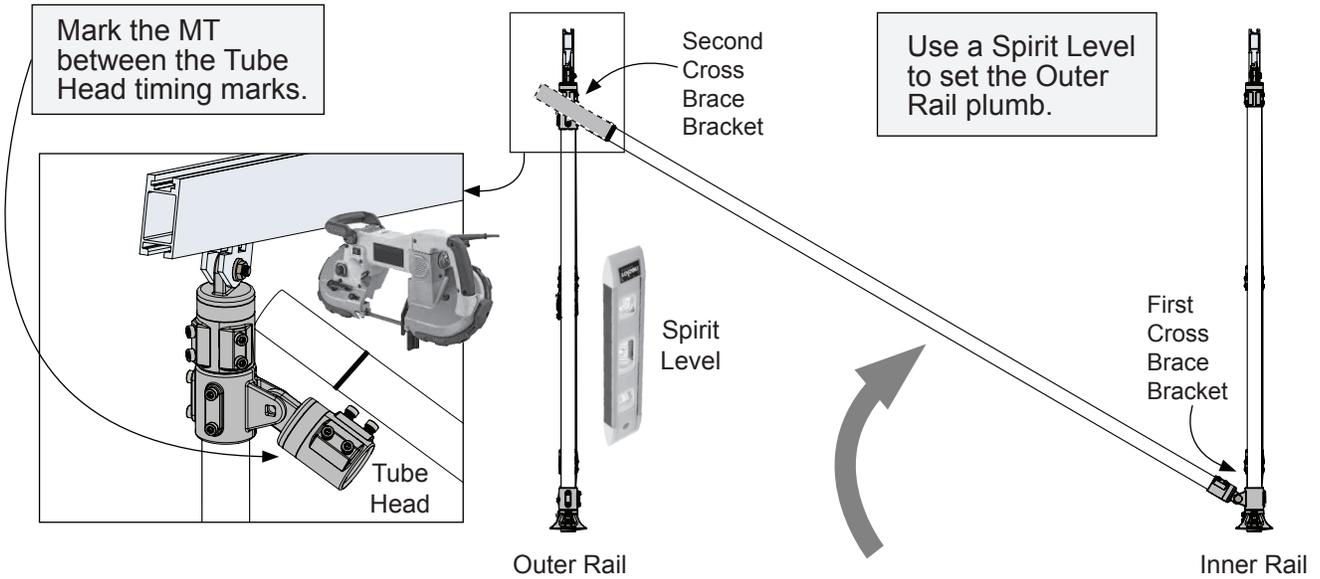
- (C)** Fully secure the second Cross Brace Bracket directly under the Post Mount.



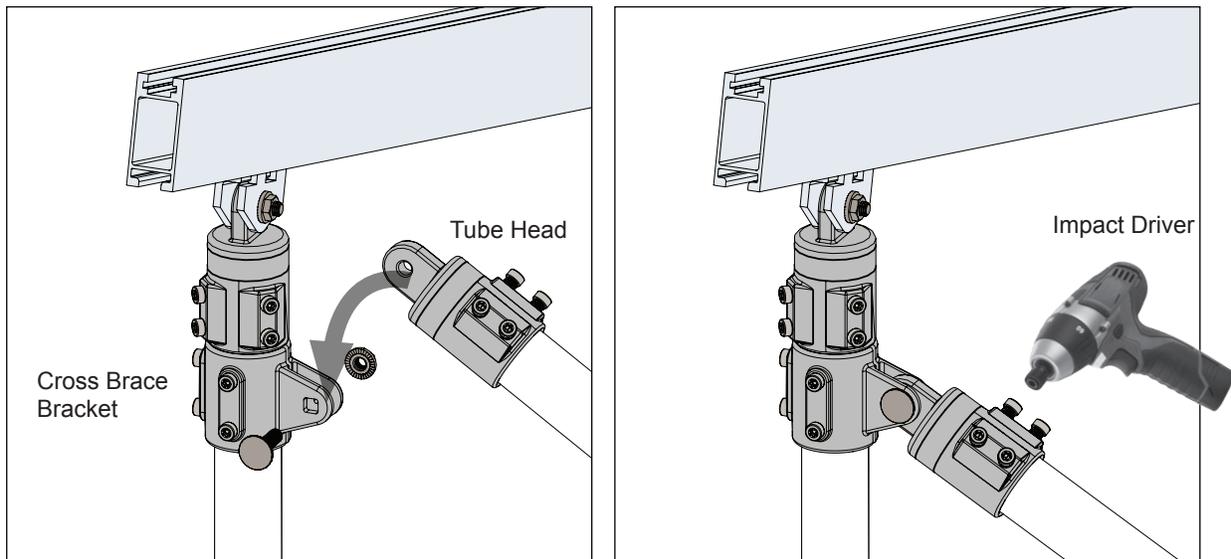
Second Cross Brace Bracket should touch bottom of Post Mount.

Install E-W Cross Bracing, Continued

- C Raise the MT up to second Cross Brace Bracket. Use a Spirit Level to set the Outer Rail plumb. Hold up a Tube Head to mark the MT between the Tube Head timing marks, then cut.



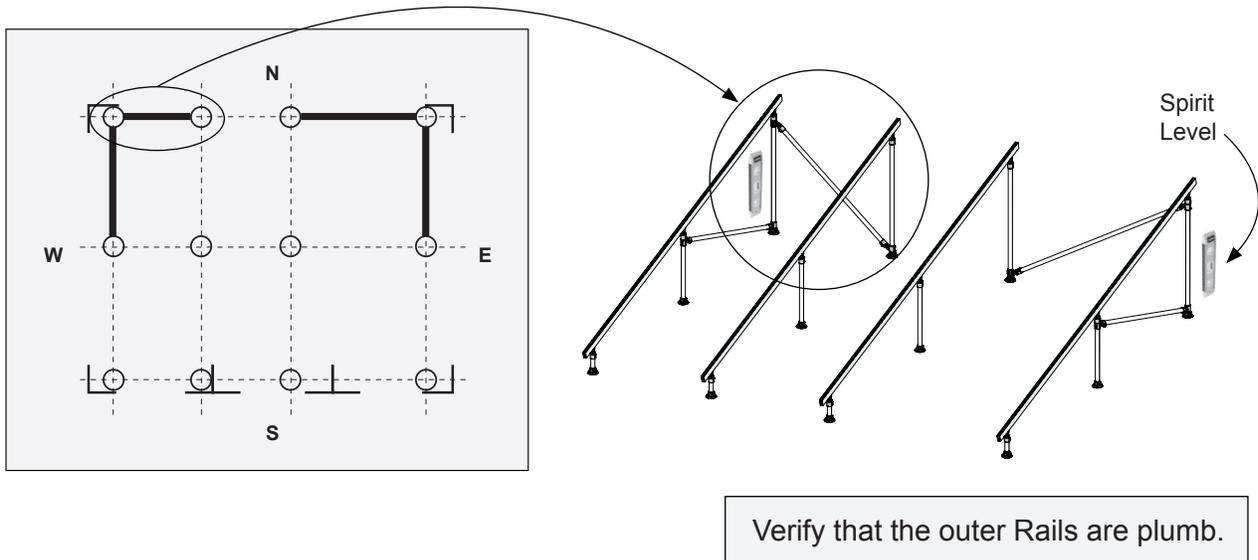
- D Fit Tube Head onto the MT to ensure proper fit, adjusting or modifying the MT as needed. Once verified, fully secure all fasteners.



FIRST, secure the Tube Head onto the Cross Brace Bracket. THEN secure the Tube Head onto the MT.

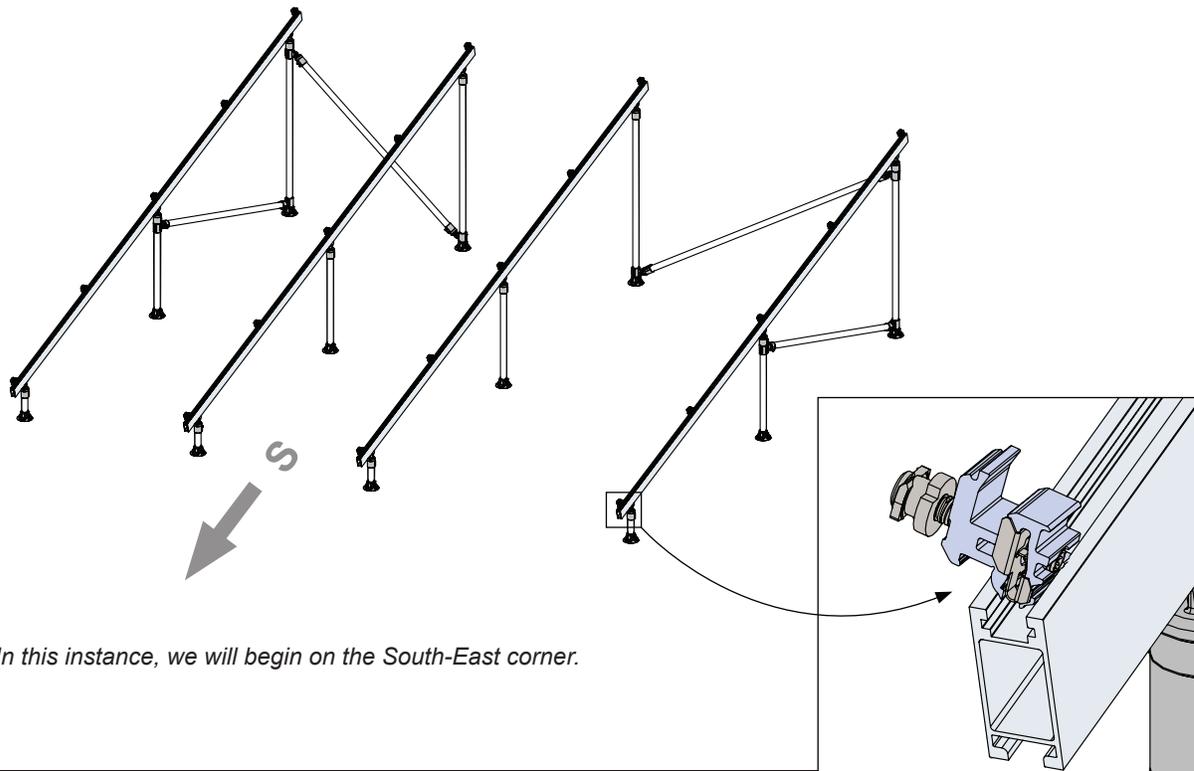
Install E-W Cross Bracing, Continued

- (E) Install an East-West Cross Bracing on the remaining side. **Verify that the outer Rails are plumb.**



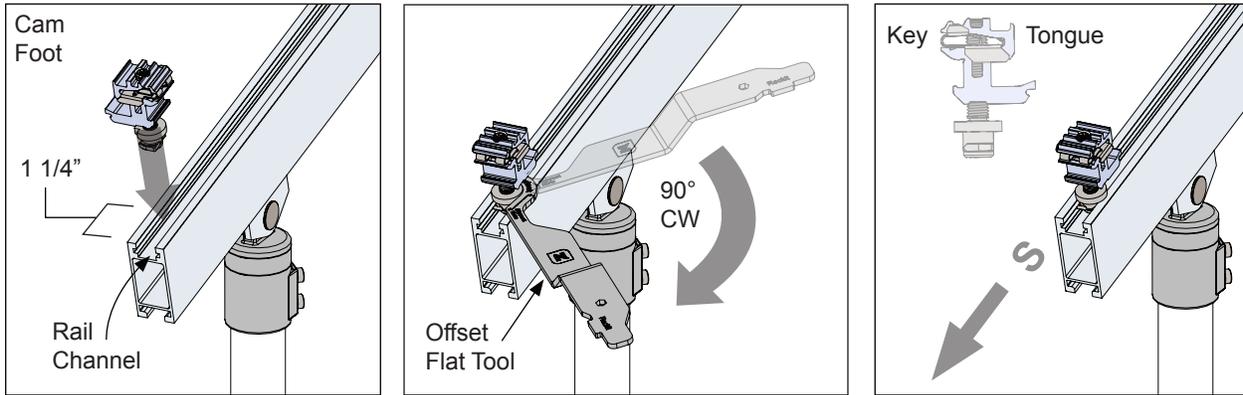
Step 7. Install Cam Feet

- (A) Stage Cam Feet onto the Rails according to the number of modules specified in the project plan set.



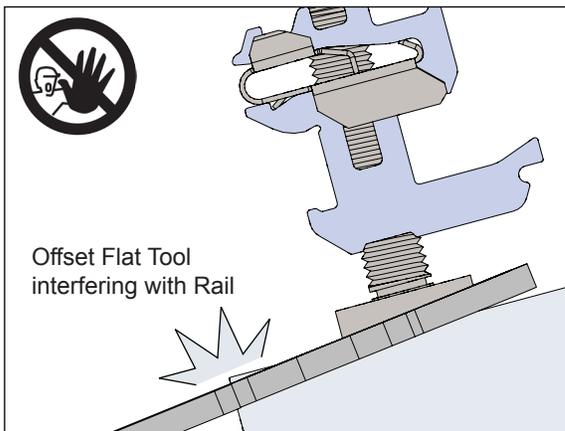
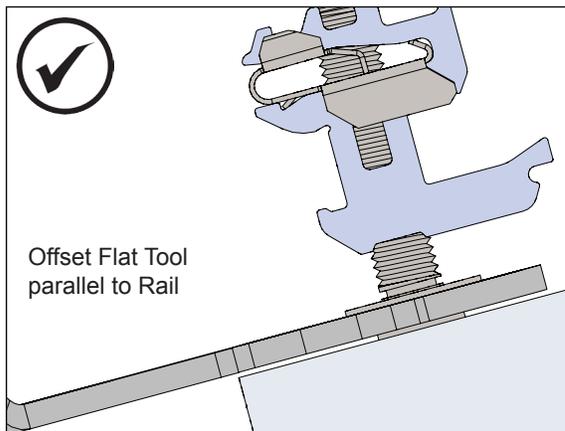
Install Cam Feet, Continued

(B) Insert the first Southern-edge Cam Foot into the Rail channel 1 1/4" from the Rail edge. Use the offset Flat Tool to turn the Cam Foot 90 degrees clockwise so that the Key side of the Rockit faces South.

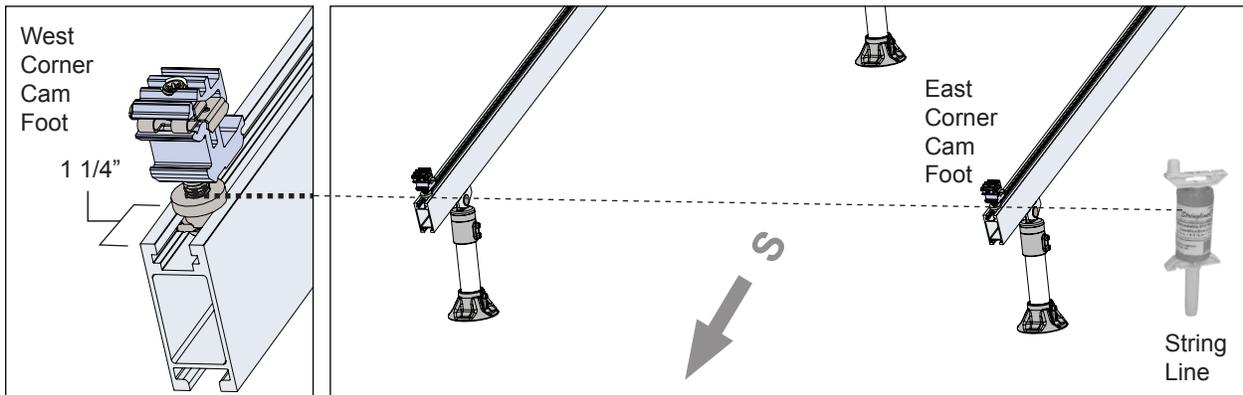


! Keep the Offset Flat Tool parallel to surface to avoid gouging the Rail.

The Key side of the Cam Foot Rockit should face South.



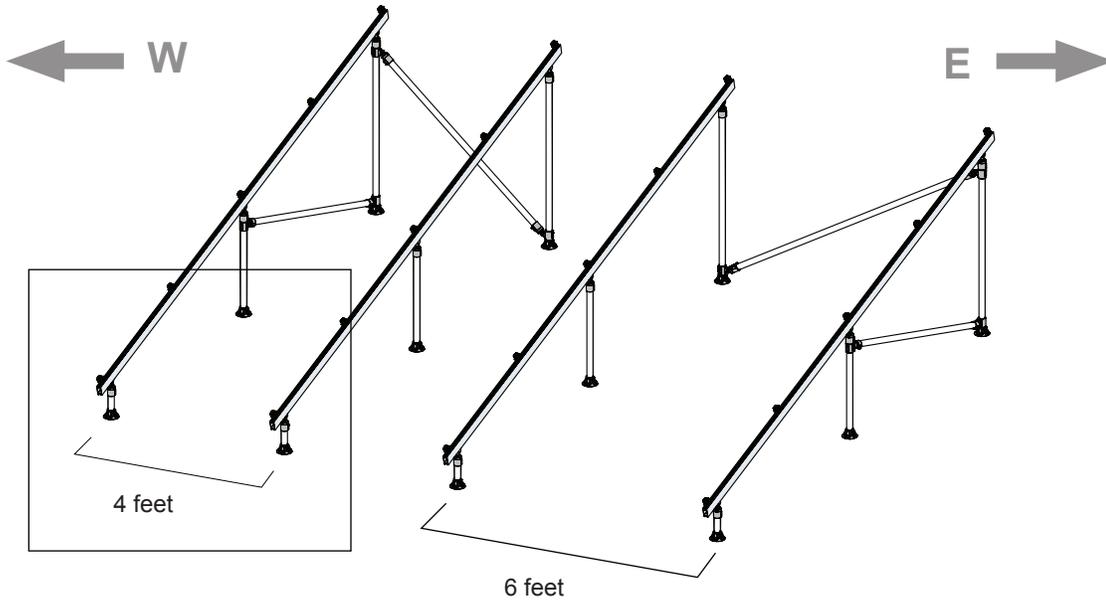
(C) Install a Cam Foot on the opposite front corner, 1 1/4" from the Rail edge. Then set a String Line between the corner Cam Feet to define the alignment of the first row. Install the remaining Cam Feet.



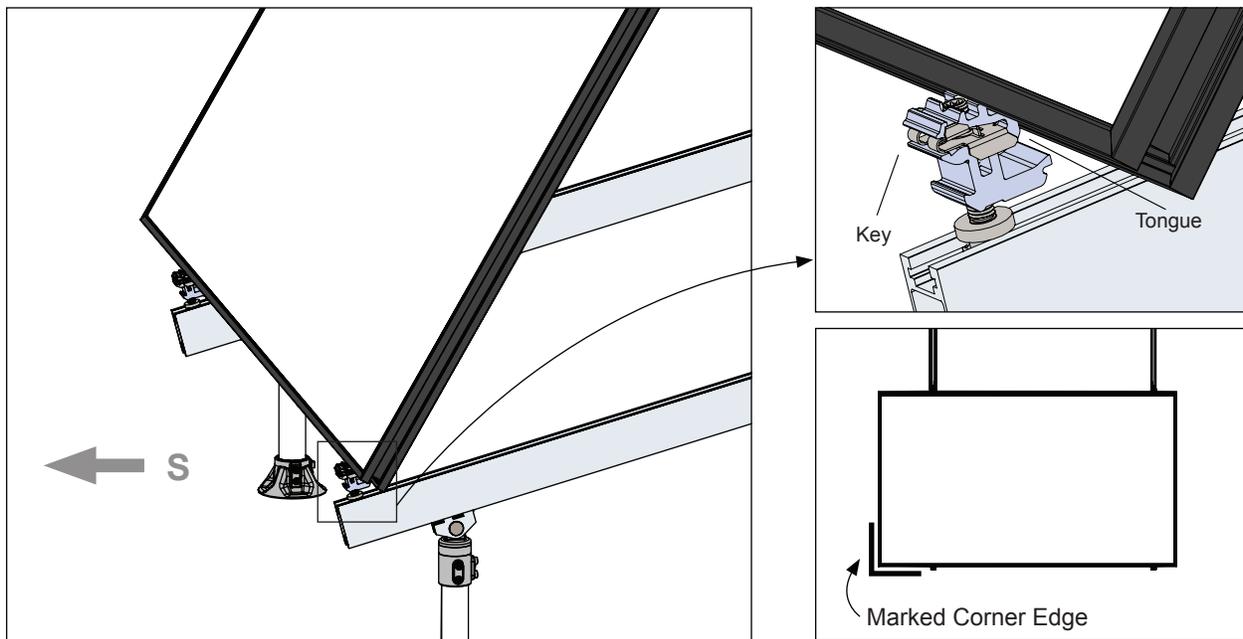
Step 8. Option A: 2-Point Drop-In

- (A) If your project plan set specifies a distance between Rails that is 4 feet or less, identify which corner (South-East or South-West) to begin installation.

In this instance, we will begin on the South-West corner.

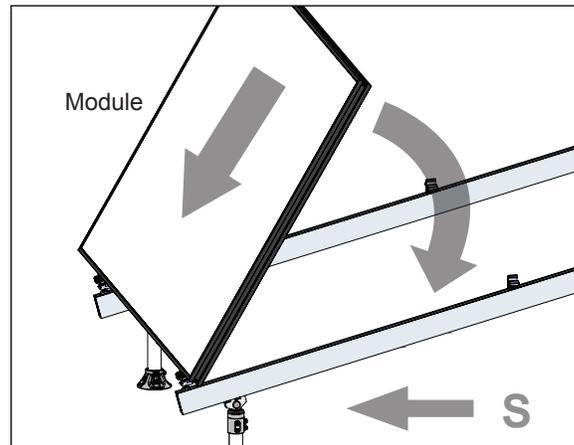


- (B) Set a module onto the Tongue side of the Cam Foot Rockits. Align the module with the marked corner edge.

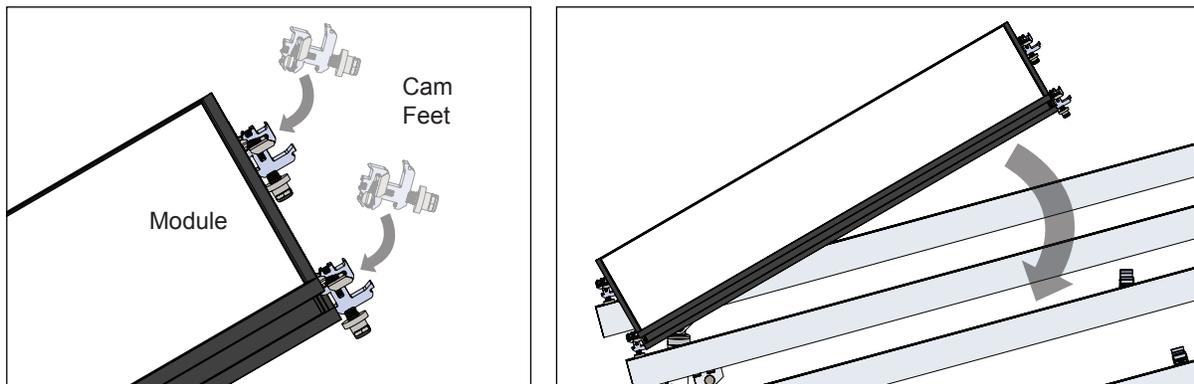


Option A: 2-Point Drop-In, Continued

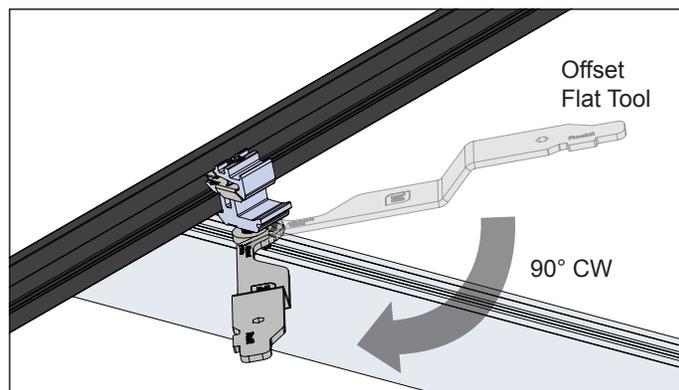
- (C) Push while rocking the module down to ensure proper seating.



- (D) Before completely lowering the module, engage two Cam Feet at the back side of the module where they will meet their respective Rails. Fully rock the module down.

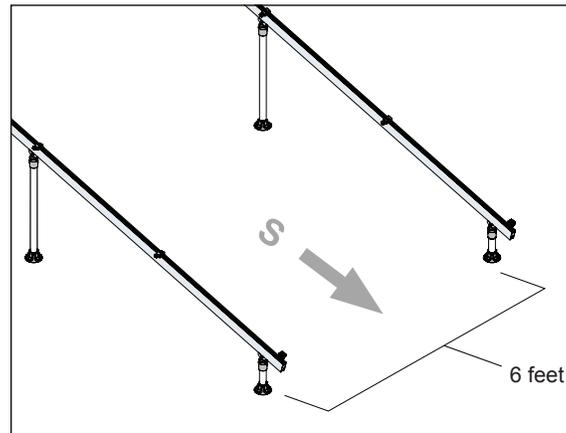


- (E) Insert the Cam Feet into their respective Rail channels and use the Flat Tool to secure them 90 degrees clockwise.



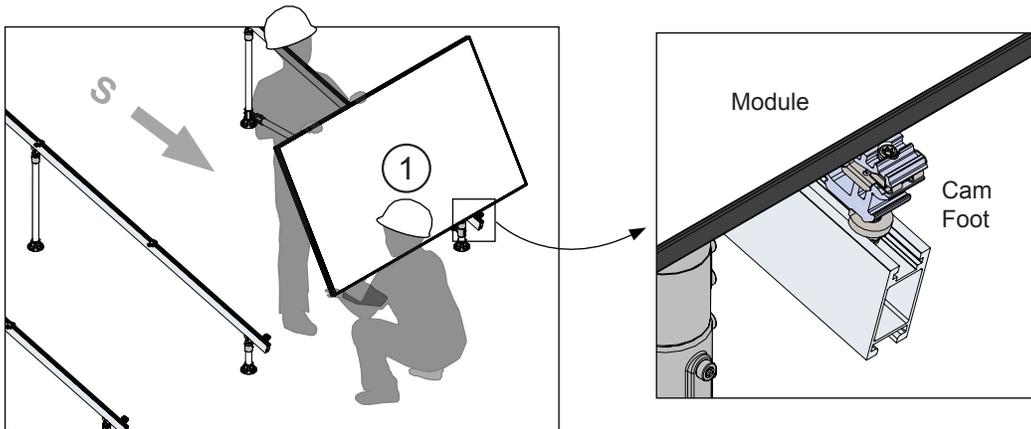
Step 9. Option B: 1-Point Drop-In

- (A) If your project plan set does not have Rails at a distance of less than 4 feet, OR if you are installing in Portrait, you will need to follow a three-person operation to install the first AND second module simultaneously.

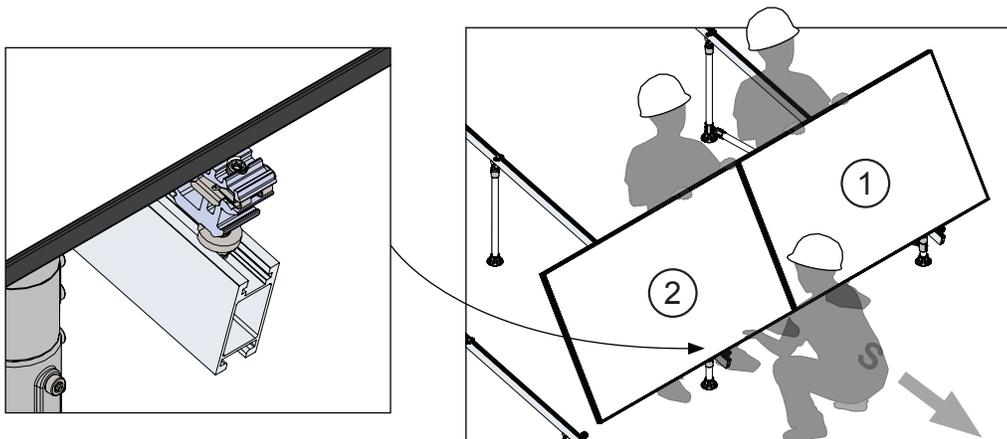


In this instance, we will begin on the South-East corner.

- (B) Have the first installer lift up the first module onto a Cam Foot while a second installer provides support.

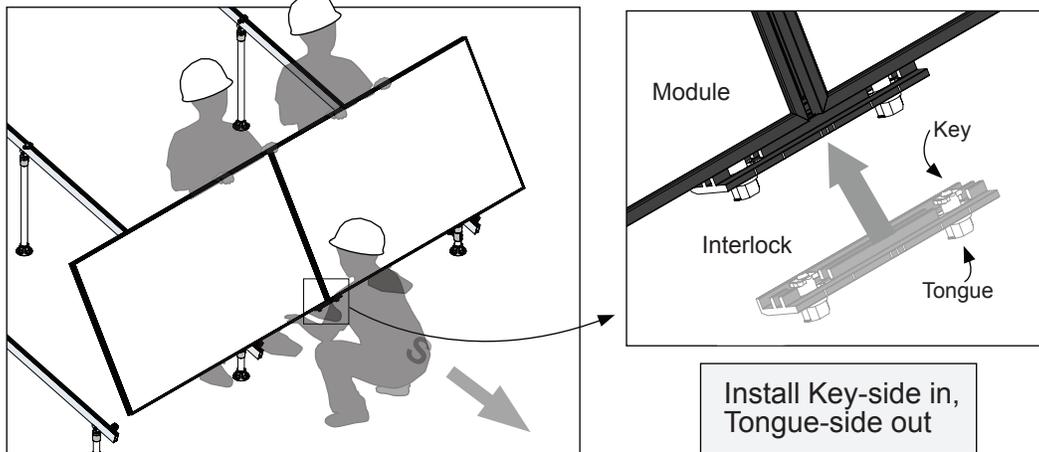


- (C) Have a third installer lift up a second module onto its Cam Foot while the second installer provides support.

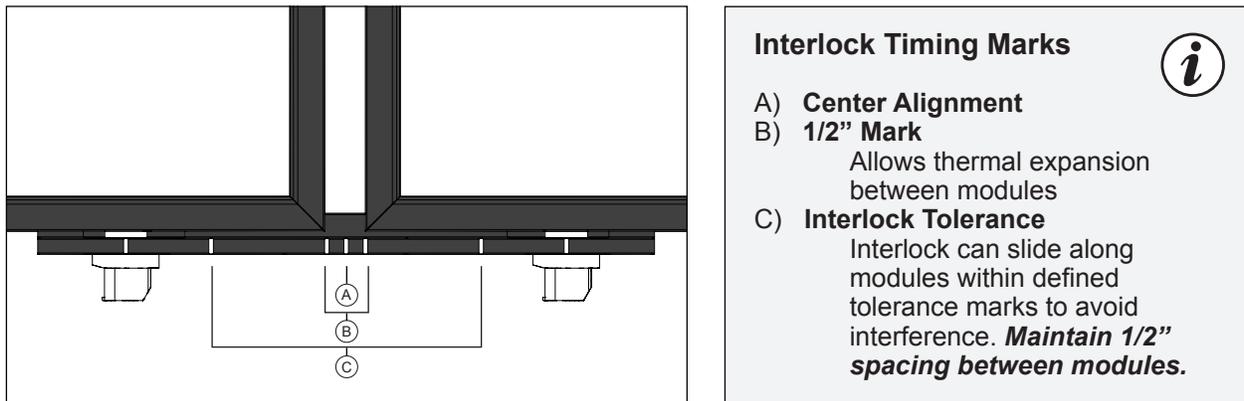


Option B - Install the First AND Second Module, Continued

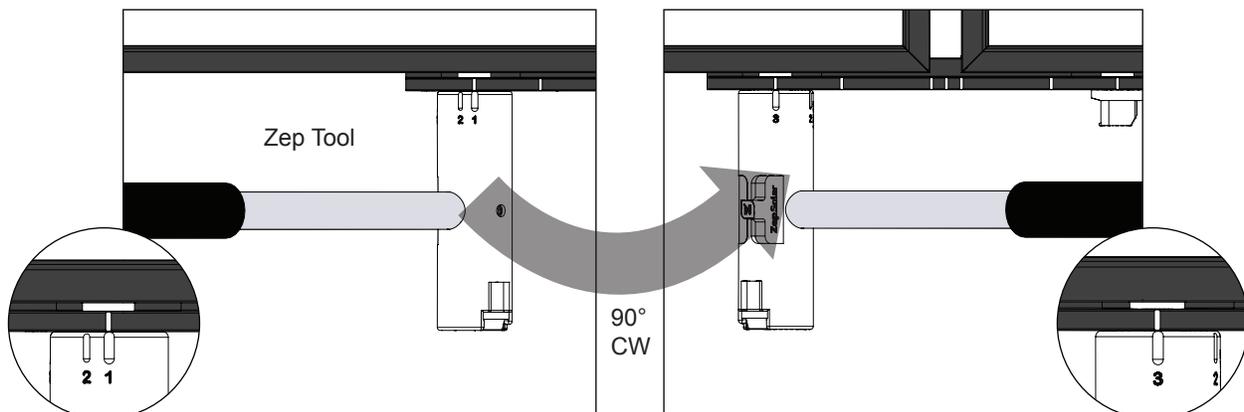
D While the first and third installers hold the modules in place, have the second installer insert an Interlock into the Zep Groove of the two modules.



E Align the Interlock so that the edges of the modules fall on the appropriate timing marks.

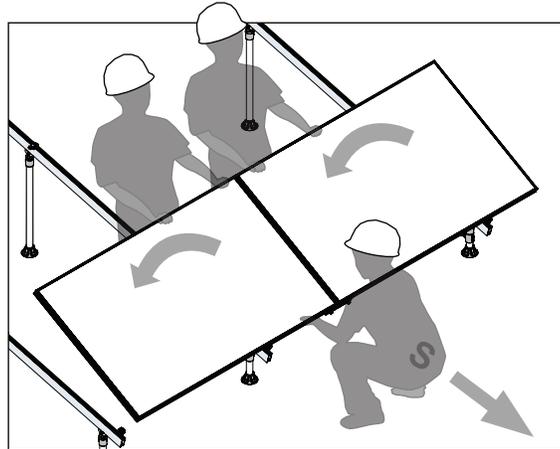


F Use the Zep Tool to turn the Interlock Zep 90 degrees clockwise from position 1 to position 3 on the Zep Tool Timing Marks.

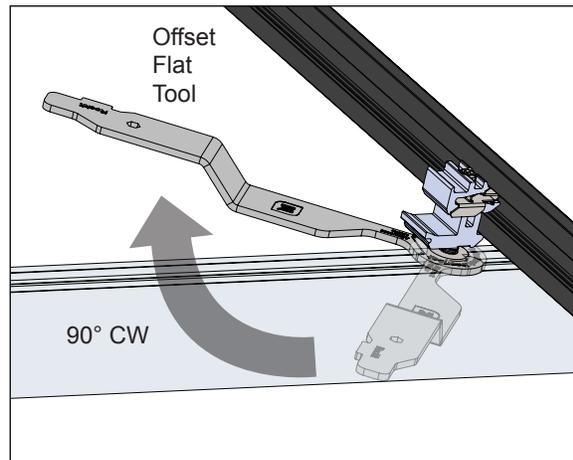
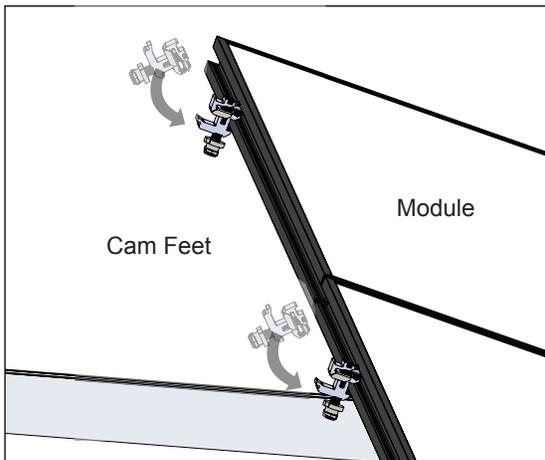


Option B - Install the First AND Second Module, Continued

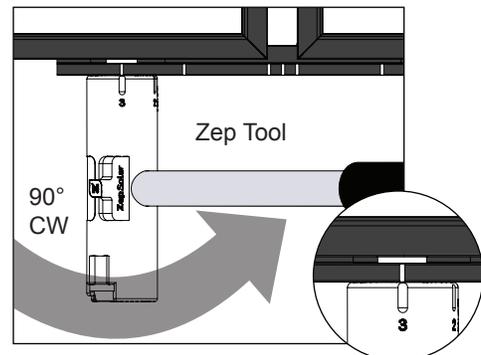
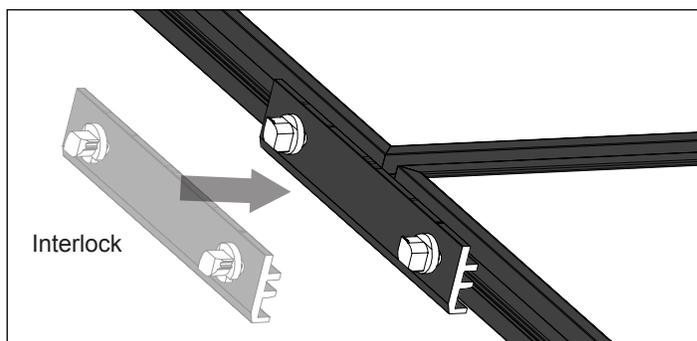
- G Have the first and third installers rock in BOTH modules with the second installer's support.



- H Install one Cam Foot onto the backs of the two modules where they will meet their respective Rails. Fully rock down the two modules and secure the Cam Feet with the Offset Flat Tool.

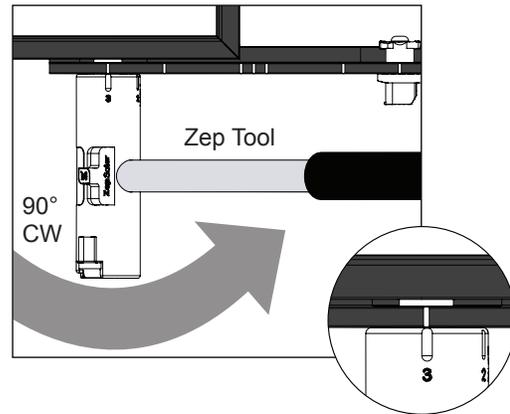
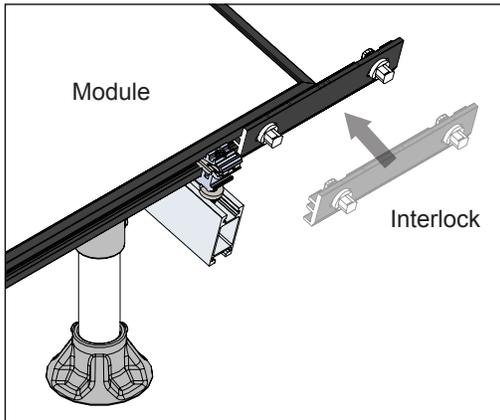


- I Install an Interlock Key-side in on the back of the two modules.

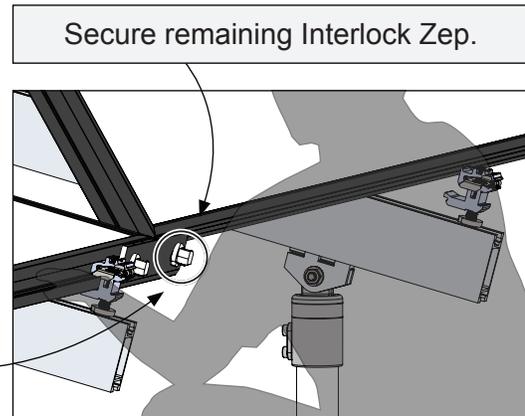
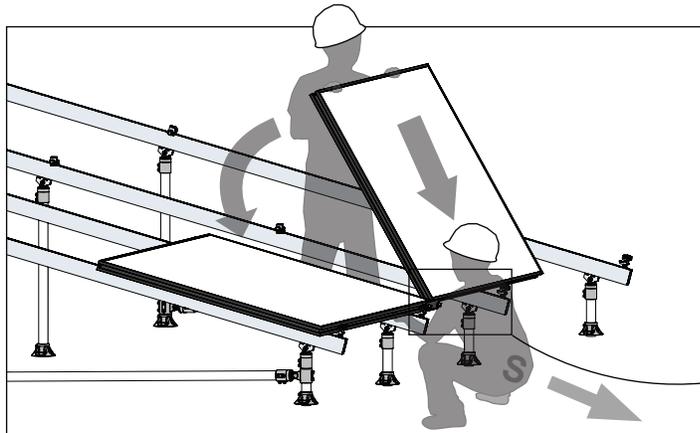


Step 9. Complete First Row of Modules

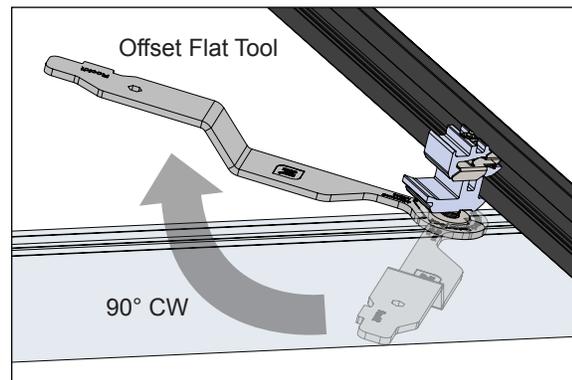
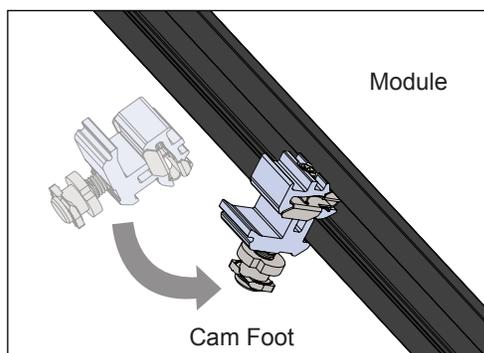
- (A) Install an Interlock into the Zep Groove of an installed module. Fully secure the half of the Interlock that is inserted into the Zep Groove.



- (B) With the help of a second installer, drop in a module onto the Tongue side of the Interlock and Cam Foot. Push while rocking the module down to ensure proper seating, then secure the remaining Interlock Zep.

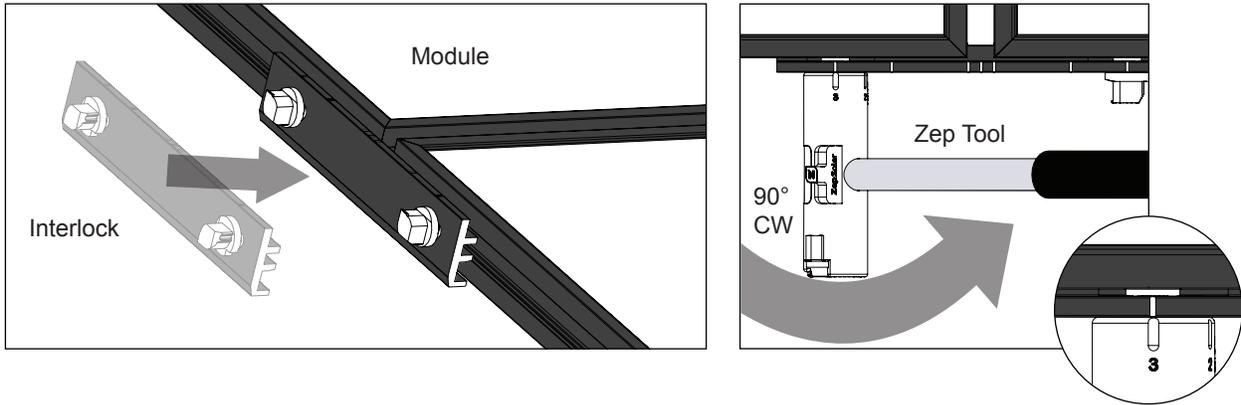


- (C) Before completely lowering the module, engage ONE Cam Foot at the back of the module where it will meet its Rail. Fully rock down the module and secure the Cam Foot with the Offset Flat Tool.

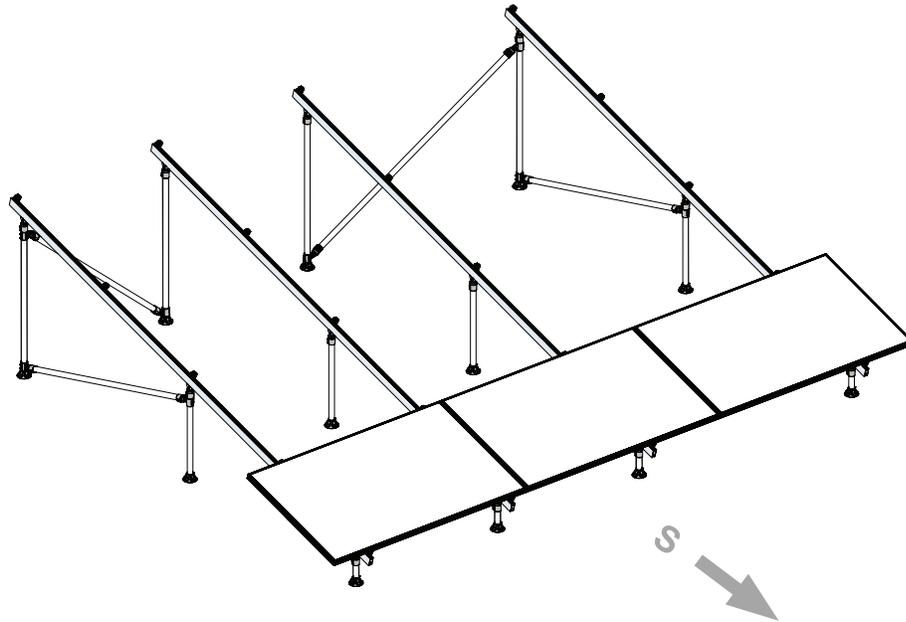


Complete First Row of Modules, Continued

D Install an Interlock onto the back of the two modules.

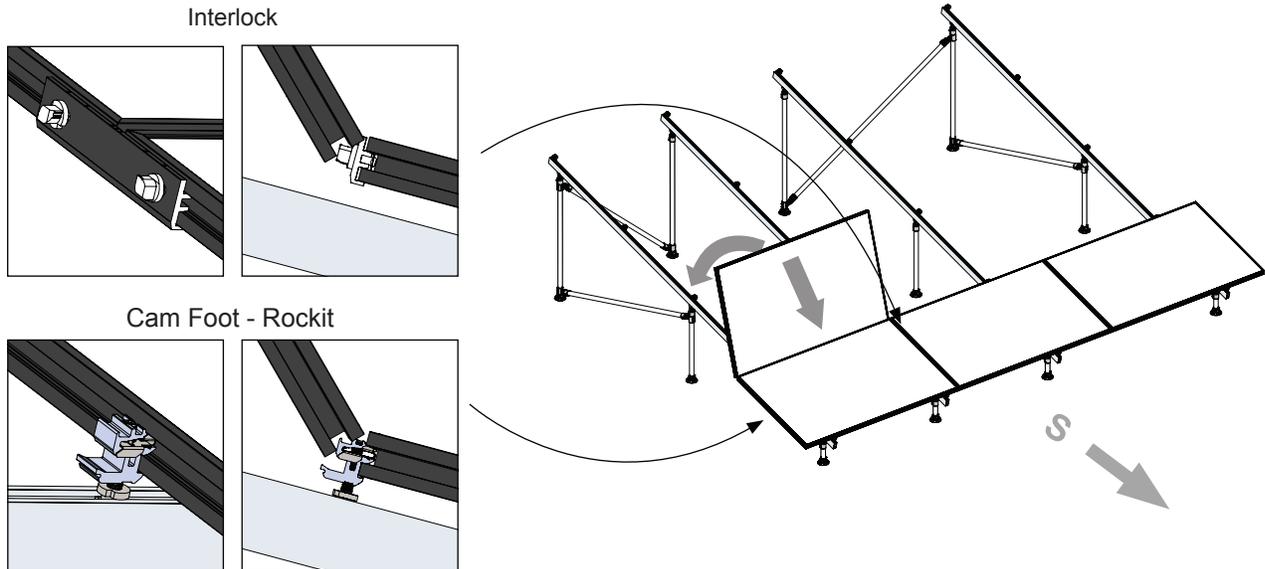


E Repeat until the row is complete.

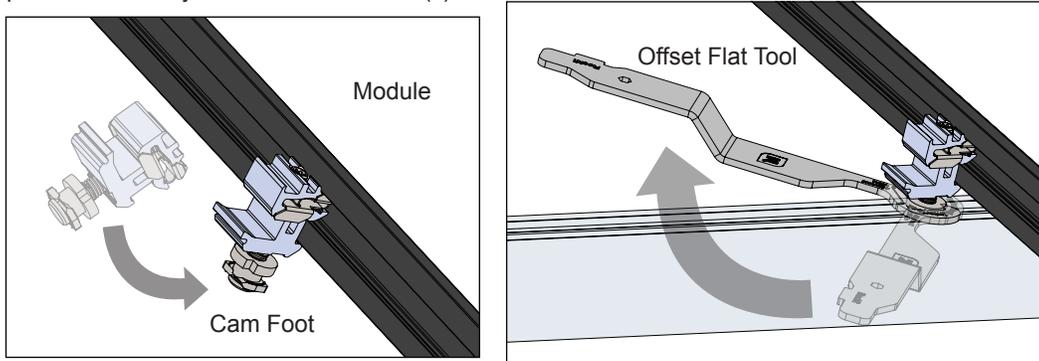


Step 10. Complete Remaining Modules

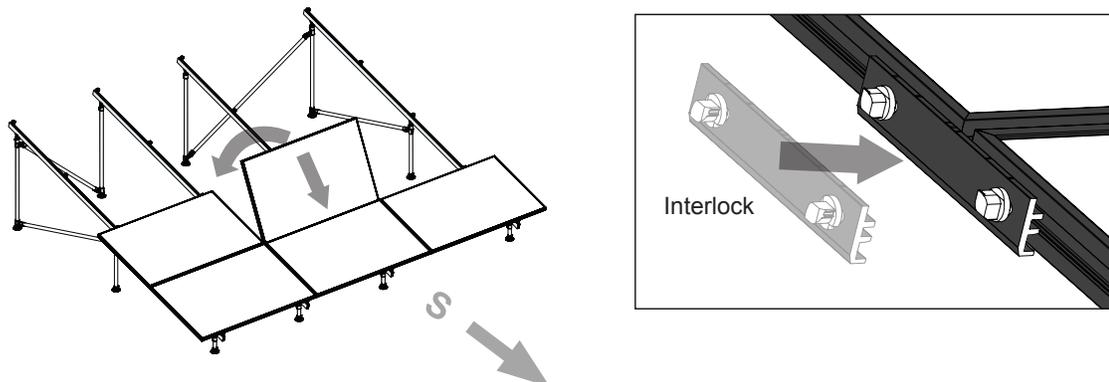
- (A) At the top of the second row, rock the module onto the Tongue side of the Cam Foot Rockit(s) and the Key side of the Interlock.



- (B) Before completely lowering the module, engage Cam Foot(s) at the back of the module where it will meet its respective Rail. Fully secure the Cam Foot(s).

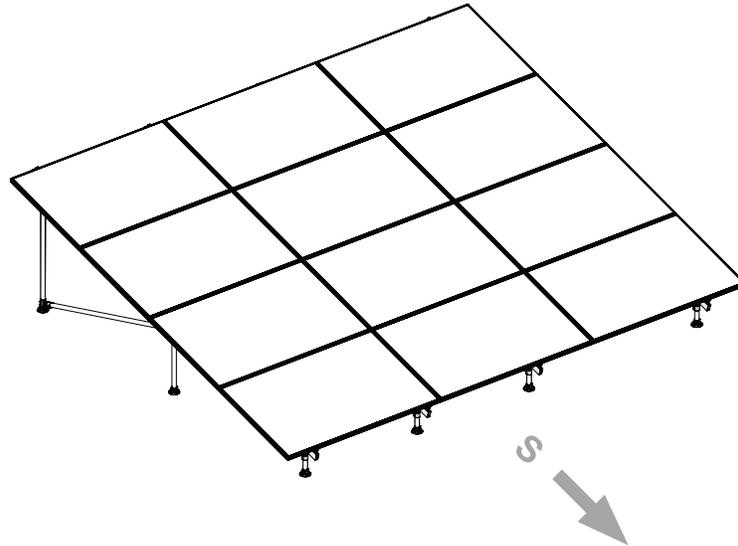


- (C) Drop in the next module, then install an Interlock onto the backs of the two modules.



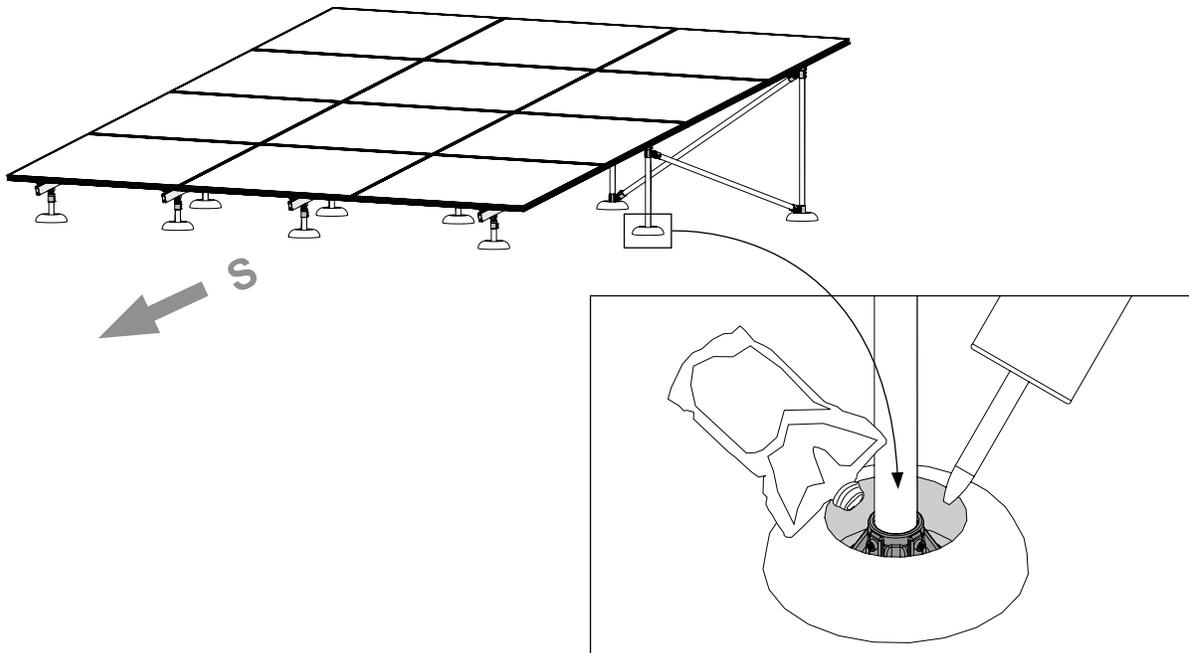
Complete Remaining Modules, Continued

- (D) Repeat until the array is complete.

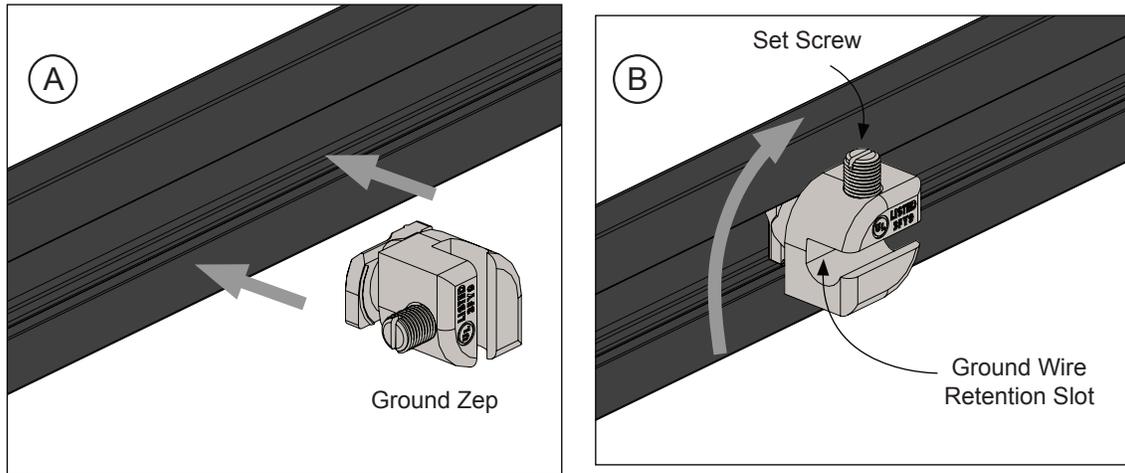


Step 11. Install Sealant Tub

Install a sealant tub at every Base Foot, according to the manufacturer's installation procedures.



Step 12. Ground the Array



Installation: Insert a Ground Zep into the Zep Groove with the label facing out and set screw pointing left. Use the Zep Tool (or Flat Tool) to turn the Ground Zep 90 degrees clockwise so that the set screw is pointing up.

Insert solid copper ground wire into the Ground Wire Retention Slot.

To fully secure the ground wire, torque the set screw as follows:

14-10 AWG:	40 inch-lbs
8 AWG:	45 inch-lbs
6 AWG:	50 inch-lbs
4 AWG:	55 inch-lbs

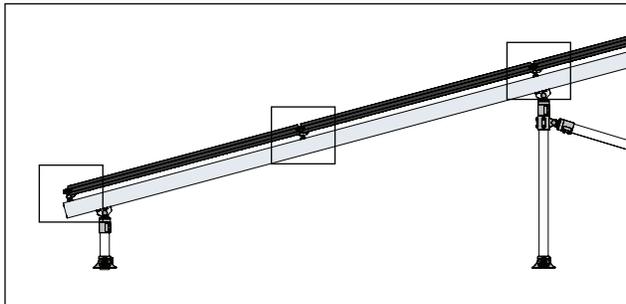
The Ground Zep (Part No. 850-1511) is UL listed to UL 467 and UL 2703.

Grounding and Inter-Array Bonding

Auto Bonding. The Key side of the Cam Foot Rockit, the Tongue side of the Cam Foot Rockit, the Nut of the Cam Foot, and the Key side of the Interlock Zep establish a structural and electrical bonding connection between modules and other Zep Solar components. Rotating a module down onto the tongue side of the Cam Foot Rockit or Interlock Zep, or turning the Cam Foot into the Rail, or engaging the Interlock Zep into the Zep Groove of a module establishes an equipotential bond by cutting through the surface coating on the Zep Groove.

Bond Paths. Each contiguous ZS Ramp array is a single hyper-bonded matrix. Bond paths are as follows:

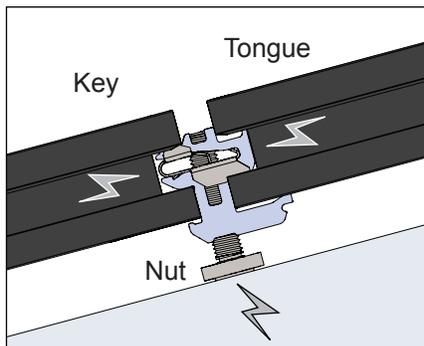
- Cam Foot to Zep Groove of module frame
- Interlock to Zep Groove of module frame
- Tube Assembly components to one another, when fully assembled
- Rails to Cam Feet
- Ground Zep to Zep Groove of module frame



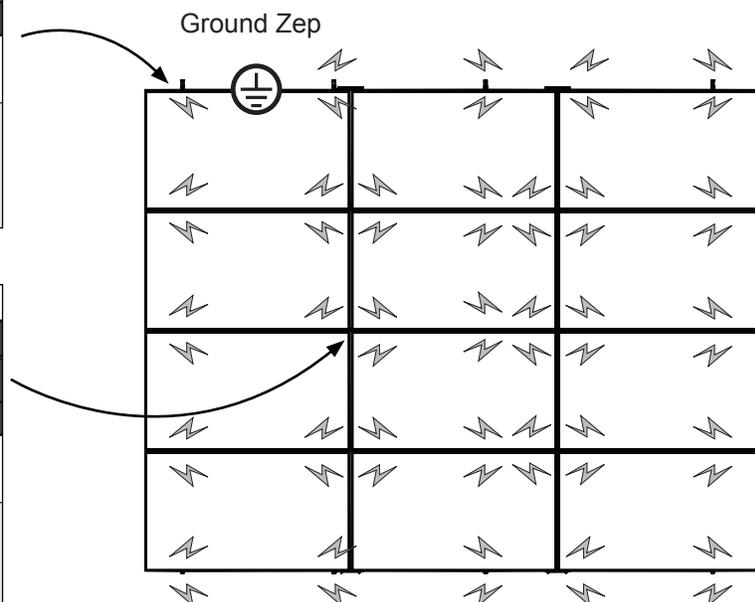
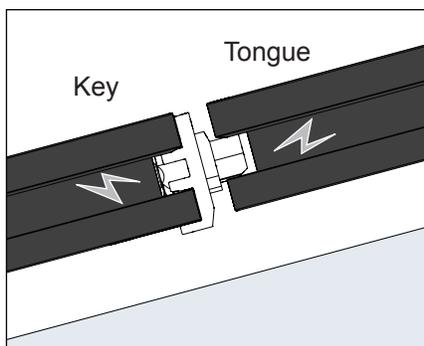
The Ground Zep (Part No. 850-1511) is UL listed to UL 467 and UL 2703.

Because each contiguous array is a single hyper-bonded matrix, it is not necessary to run copper ground wire to every module, only from the Ground Zep itself.

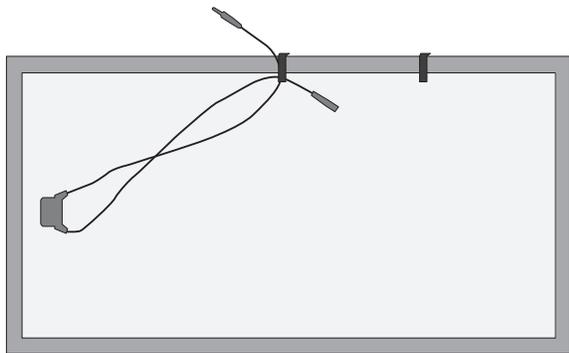
Cam Foot



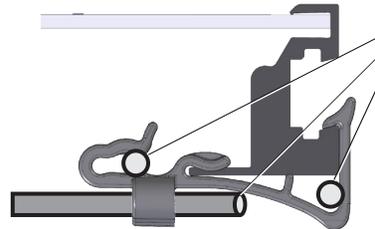
Interlock



Wire Management Recommendations



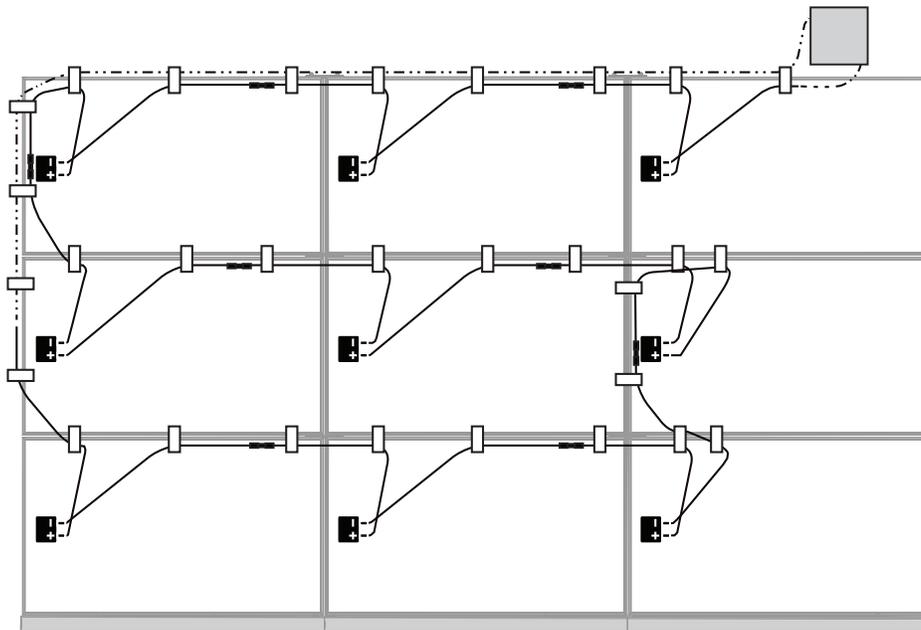
The example above shows pre-wiring or staging of modules prior to installation using the DC Wire Clip.



DC Wire Clip accommodates up to three wires.

The DC Wire Clip (Part No. 850-1448) is UL listed to UL 1565 as a Wire Positioning Device.

Example: Array Wiring for a standard 3x3 module array



- | | | | |
|---|--------------|---|----------------|
|  | DC Wire Clip |  | Wire Connector |
|  | Junction Box |  | Wire |
|  | Combiner Box |  | Home Run Wire |

Important Safety Precautions

Follow all instructions in this manual and the PV module installation manual. The installer is ultimately responsible for ensuring that all installations are performed in compliance with applicable codes and standards, as well as industry best practices.

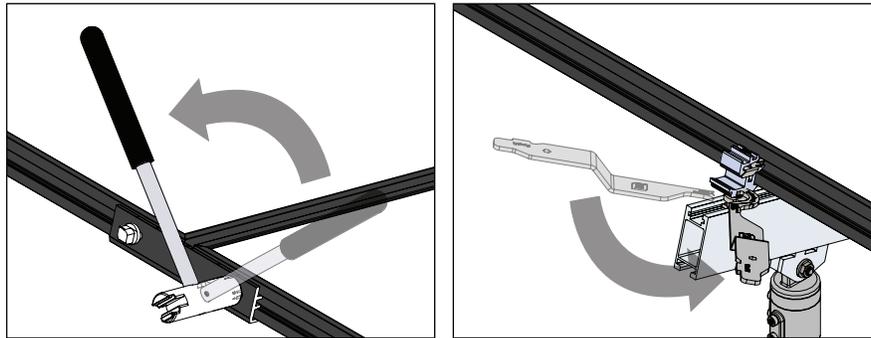
Electrical Specifications

- These instructions describe the correct installation of the Ground Zep and other listed components into a PV module that has a Zep Compatible frame.
- Product listing information is shown for each component in the Components section.
- Zep Solar components are only suitable for PV modules with a series fuse rating of 20 Amps or less.
- Each array of PV modules must be grounded with a solid copper wire that is connected between the Ground Zep and a suitable earth ground.

Module Servicing

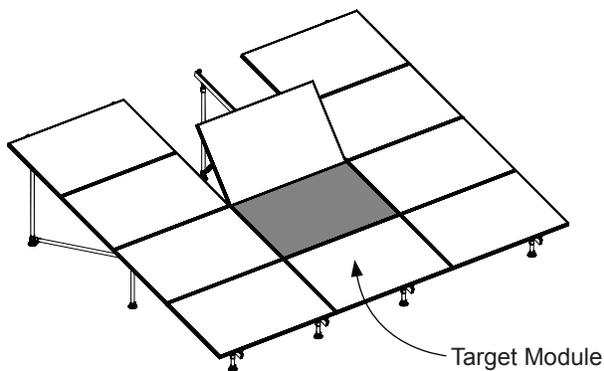
To service individual modules within a ZS Ramp array, do the following:

1. Follow SolarCity's standard Lock Out Tag Out procedure.
2. Disconnect module wires.
3. From the back row, loosen Interlocks and Cam Feet with an Offset Flat Tool and remove the module.
4. Continue to uninstall modules as necessary to reach the target module.
5. Replace with a new module.
6. Fasten Interlocks and Cam Feet with an Offset Flat Tool.
7. Continue to install modules until complete.

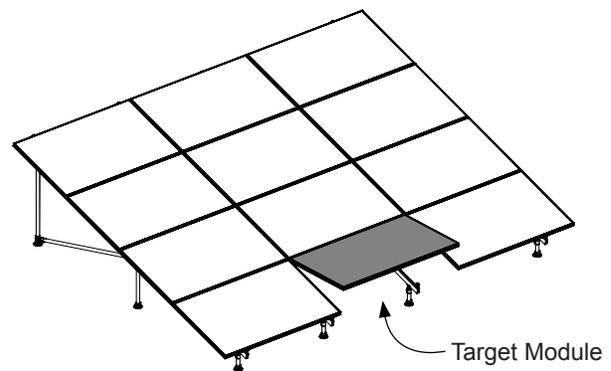


It is generally easier to remove and replace modules from the back.

Example 1: Target Module located inside array



Example 2: Target Module located on Front Row



If needed, it is possible to remove front row modules from the front.