

TESLA | ZS RAMP

INSTALLATION MANUAL

RAIL BASED APPLICATIONS FOR LOW SLOPE ROOFS



DISCLAIMER OF LIABILITY

Tesla Incorporated (“Tesla”) and its subsidiaries are not liable for any damages caused by failure to follow the instructions and guidelines found in this manual, or from inappropriate use or maintenance of PV modules. This includes, without limitation, any damages, losses, and expenses caused by non-observance of the instructions of this manual, as well as damages, losses, and expenses caused by, or in connection with, products of other manufacturers.

NOTICES

This manual contains safety, installation, configuration and troubleshooting instructions for Tesla Zep Compatible™ Systems (ZS) products. Tesla recommends that you save this manual in a readily accessible location, should any questions arise.

Tesla ZS Ramp is UL 2703 Listed for Bonding.

Tesla ZS Ramp has a IEC/UL 61730 Class “A” Fire Rating when installed on steep slope roofs using modules from any manufacturer certified as “Type 1” or “Type 2.”

Tesla 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.

Tesla ZS Ramp may only be used to ground and mount Zep Compatible™ PV modules.

All Tesla Zep Compatible™ modules comply with IEC/UL 61730 and have been evaluated for grounding and mounting in compliance with the included instructions. Zep Compatible™ modules are identified by the Zep Solar logo on their label.

Tesla Zep Compatible™ components are only suitable for PV modules with a series fuse rating of 20 Amps or less.

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North-South Bracing

East-West Bracing

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2. Mark and cut mechanical tubing to length
3. Install upper end of Tube Head

STEP 7: Install First Row Cam Feet 22

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2. Install outer Cam Feet for first row
3. Use a String Line to install inner Cam Feet

STEP 8 OPTION A: Install First Row Modules, 2-Point Drop In 24

1. Set and partially rock down the module
2. Rock down the module and Engage Rear Cam Feet
3. Fasten Cam Feet

STEP 8 OPTION B: Install First Row Modules, 1-Point Drop In 25

1. Position the modules using three installers
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3. Rock down both modules
4. Engage Rear Cam Feet
5. Fasten Rear Cam Feet

STEP 9: Complete First Row Modules 27

1. Install Interlock
2. Install Module
3. Engage rear Cam Feet
4. Install rear Interlock
5. Repeat until row is complete

STEP 10: Complete Remaining Modules

28

1. Rock In Module
2. Engage and Secure Cam Feet
3. Drop in the Next Module and Install Interlock
4. Repeat until the array is complete

STEP 11: Install Sealant Ring

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1. Rock In Module
2. Engage and Secure Cam Feet
3. Drop in the Next Module and Install Interlock
4. Repeat until the array is complete

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IMPORTANT SAFETY INSTRUCTIONS

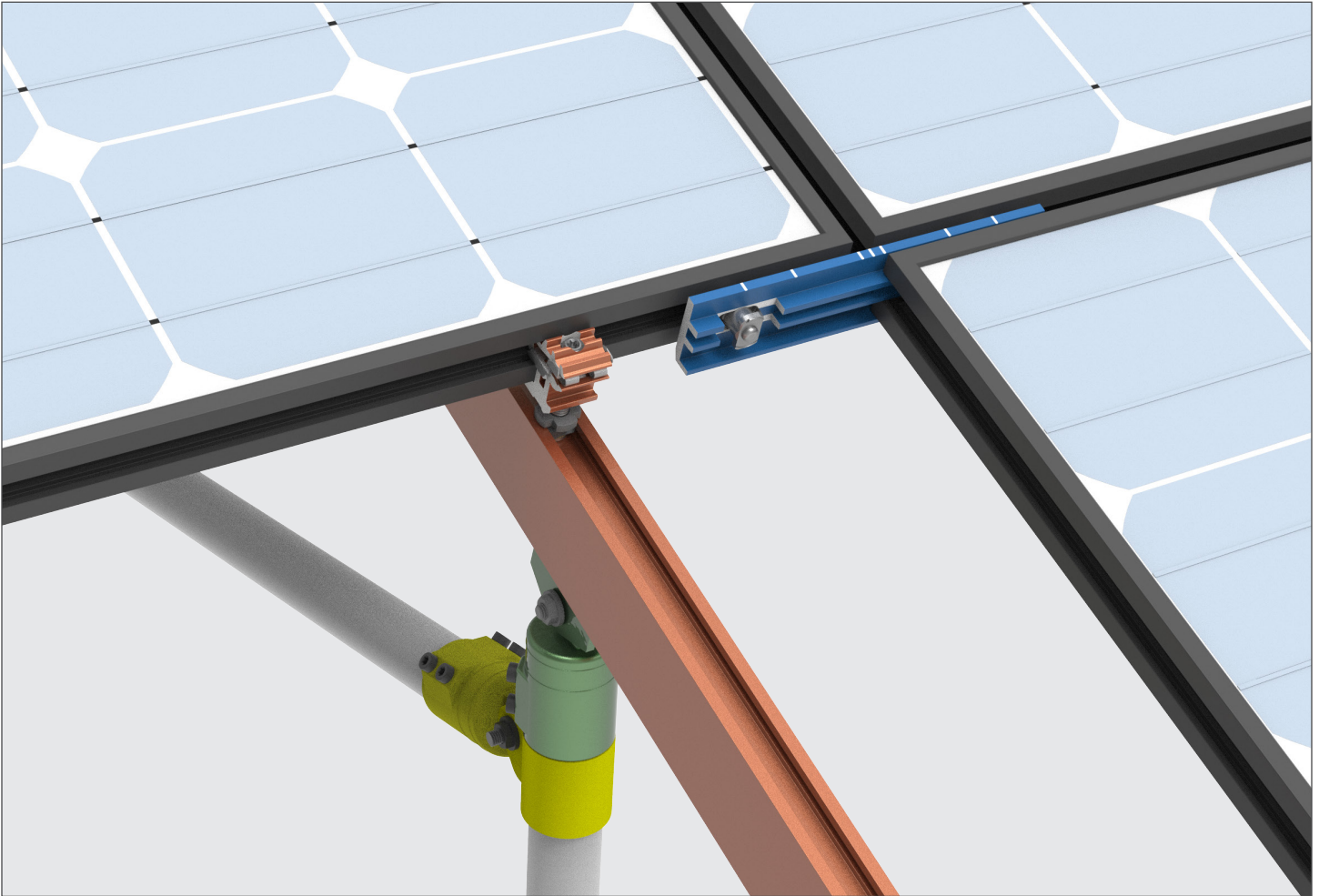
WARNING: Read and understand all instructions before you install, wire, operate, or maintain a PV system.

Failure to read and comply with any of the limitations noted herein can result in property damage, serious bodily injury, or death. The installer assumes the risk of all injury that might occur during installation, including, without limitation, the risk of electric shock.

- Always use qualified personnel for installation.
- Always follow PV module manufacturer safety precautions, installation instructions, and operating guidelines..
- Always abide by local, regional, and national statutory regulations when installing the system, and obtain a building permit if necessary.
- Always use equipment, connectors, and wiring suitable for solar electric systems.
- Always use fall protection when working from heights of 6 feet (183 cm) or above. Follow Occupational Safety and Health Act (OSHA) or local governing safety regulations regarding Fall Protection.
- Always use insulated tools that are approved for working on electrical installations.
- Always wear suitable personal protection equipment (PPE) to prevent the risk of personal injury, such as fall hazards or electrical hazards.
- Always exercise caution when transporting and installing PV modules.
- Always wear non-slip gloves when carrying PV modules.
- DO NOT wear metallic rings, watchbands, earrings, nose rings, lip rings, or other metallic objects while installing or troubleshooting PV systems.
- DO NOT contact or touch electrically charged, accessible live parts of PV modules, such as terminals.
- DO NOT touch the PV module unnecessarily during installation.
- DO NOT attempt to make an electrical connection with wet, soiled, or otherwise faulty connectors.
- DO NOT use a PV Module with broken glass or torn backsheet.
- DO NOT open electrical connections or unplug connectors while the circuit is under load.
- DO NOT allow children or unauthorized persons near the installation.

INTRODUCTION TO ZS RAMP

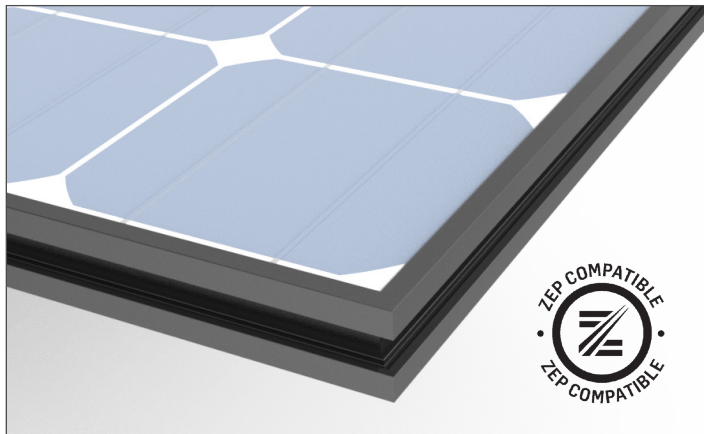
ZS Ramp is a low slope roof solution for installing PV arrays. ZS Ramp offers the following benefits: rapid installation, reduced parts count, low system weight, precision alignment, enhanced aesthetics, resistance to theft, redundant auto-grounding hardware and more.



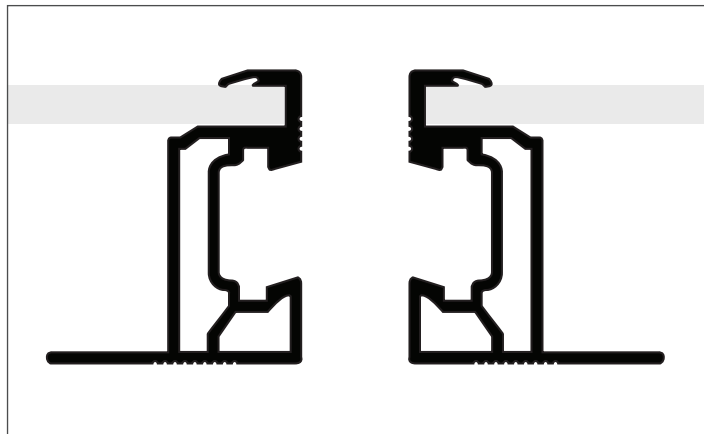
TESLA ZS MOUNTING SOLUTIONS

Tesla ZS mounting solutions are based on the Zep Groove, a patented module frame profile designed to mate easily and precisely with Tesla ZS components, creating a simultaneous structural and electrical bond with simple drop-in and precision quarter-turn connections. Zep Compatible™ PV modules are certified by Tesla to work exclusively with ZS mounting hardware.

Zep Compatible PV Module



Zep Groove



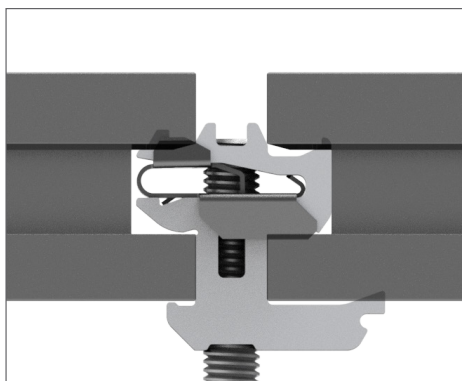
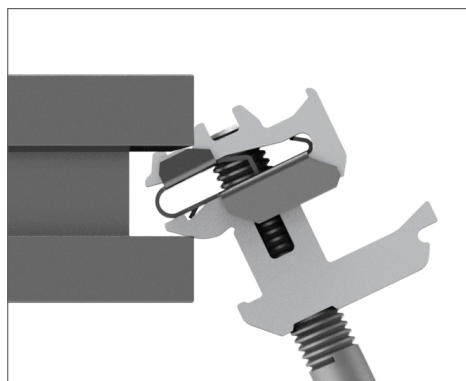
ROCKIT: KEY AND TONGUE

The Rockit is a feature common to many Zep Compatible™ hardware designs. The Key and Tongue refers to the “front” and “back” side of the Rockit. The Key side inserts into the Zep Groove, similar to inserting a key into a lock. On the other side, the Zep Groove allows PV modules to “drop in” easily onto the Tongue of the Rockit.

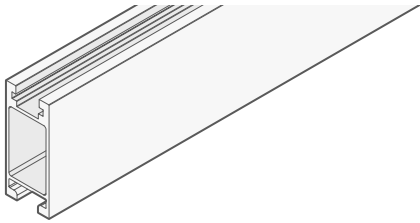
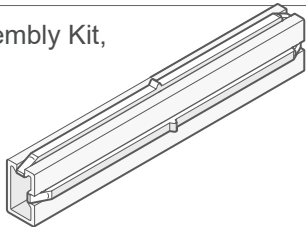
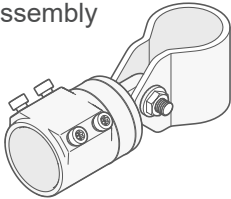
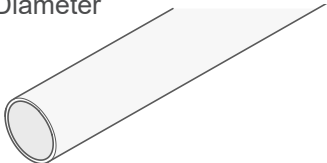
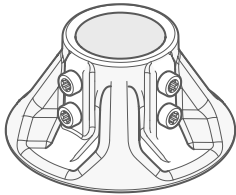


MODULE DROP-IN

Tesla Zep Compatible™ modules are typically dropped in with a downward rotation, as shown. The module's downward rotation creates forced interference with the Zep Groove of the module frame, cutting through the anodized frame to create an electrical bond.



CORE COMPO -

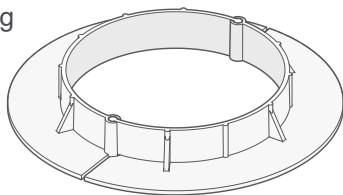
PART	DESCRIPTION	PART #
ZS RAMP COMPONENTS		
Rail 	Provides an attachment point between Cam Foot V2 and Post Mount. Listed to UL 2703	Part #850-1568, #850-1567, #850-1566 and #850-1565
Splice Assembly Kit, Ramp 	Provides attachment between adjacent rails. Listed to UL 2703	Part #850-1635
Post Mount 	Provides an attachment point between Mechanical Tubing (MT) and Rail. Listed to UL 2703	Part #850-1561
Cross Brace Assembly 	Provides lateral rigidity to adjacent columns. Listed to UL 2703	Part #850-1636
Mechanical Tubing (MT) 1.51" Outer Diameter 	Basic structural element in the ZS Ramp bracing. Listed to UL 2703	Part #850-1583
Base Foot 	Ground mounted element that attaches to the Mechanical Tubing components. Listed to UL 2703	Part #850-1563

CORE COMPONENTS

PART	DESCRIPTION	PART #
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ZS RAMP COMPONENTS

Sealant Ring



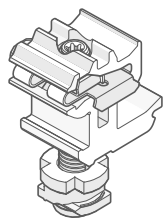
Part of the Base Foot assembly.

Part #850-1638

PART	DESCRIPTION	PART #
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GROUNDING AND BONDING COMPONENTS

Cam Foot V2

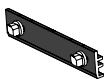


Secures PV Modules to the Rail and enables fine-tuned leveling.

Part #850-1564

Listed to UL 2703

Interlock



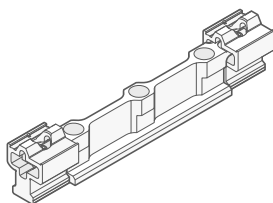
Provides structural and electrical bonding between PV modules within each sub-array.

Part #850-1388 or

Part #850-1613

Listed to UL 2703

Hybrid Interlock

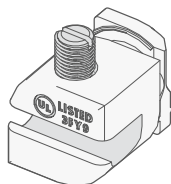


Provides structural and electrical bonding.

Part #850-1281

Listed to UL 2703

Ground Zep

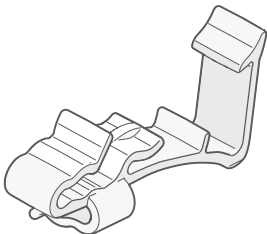
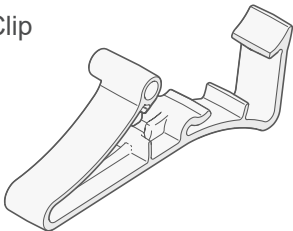


Provides a single point for grounding a PV array.

Part #850-1511

Listed to UL 467 and UL 2703

CORE COMPONENTS

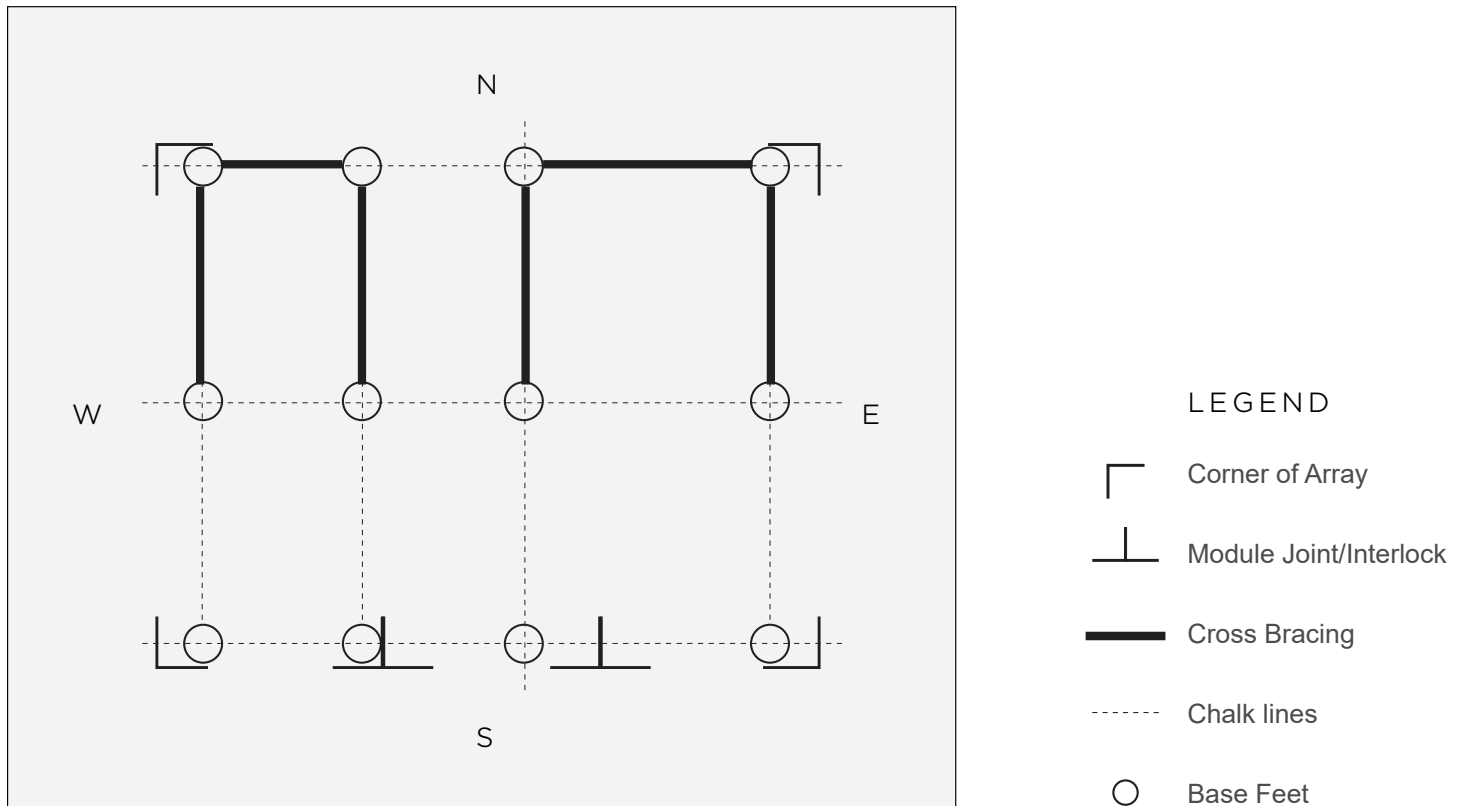
PART	DESCRIPTION	PART #
WIRE MANAGEMENT COMPONENTS		
DC Wire Clip	 Secures up to 3 conductors underneath a Tesla Zep Compatible™ PV array. Listed to UL 1565	Part #850-1509
Home Run Wire Clip	 Secures up to 5 conductors underneath a Tesla Zep Compatible™ PV array. Listed to UL 1565	Part #850-1510

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, and fire setbacks.

EXAMPLE PROJECT PLAN



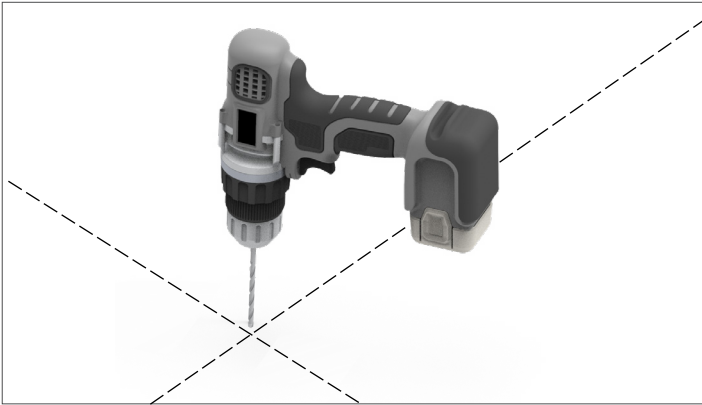
Maximum span, cantilever, and cross bracing locations are project-specific values that depend on factors such as wind zone, snow load, and neighborhood topography. Check the project plan set for these values. If project-specific values are not available, you can refer to these system-wide rules that 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 or 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.
- 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

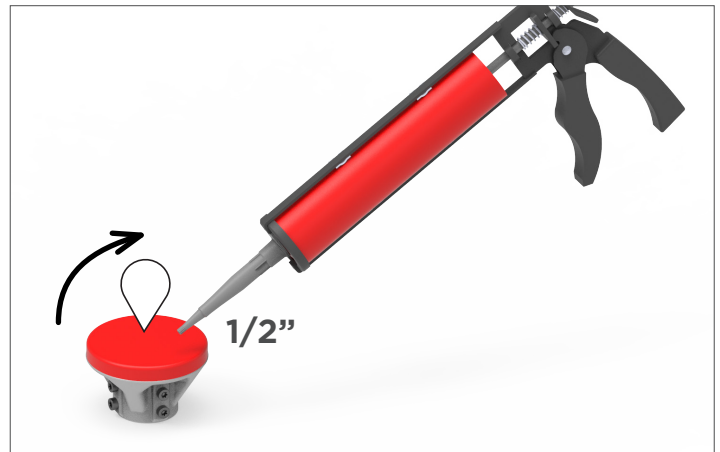
1. PILOT HOLES

Drill pilot holes at the marked locations of the Base Feet. To install on I-Joists, refer to Appendix: TJI Adaptor.



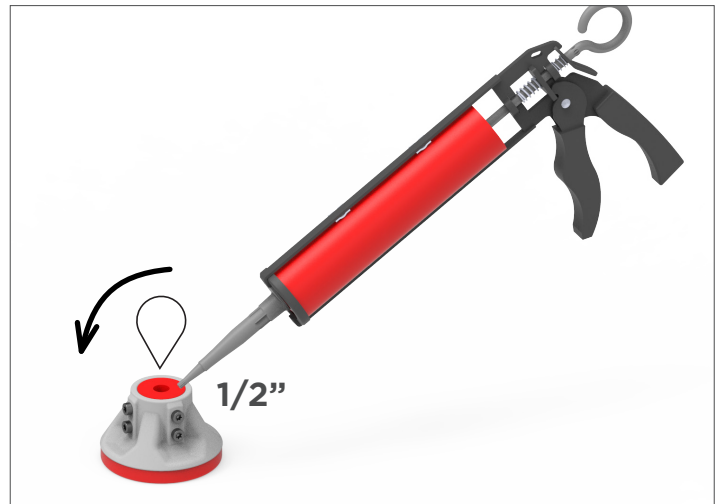
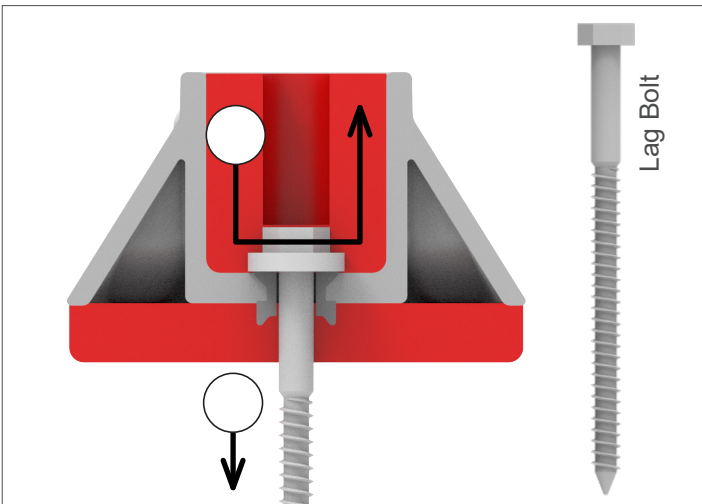
2. SEAL AT BASE

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



3. FASTEN AND SEAL INSIDE

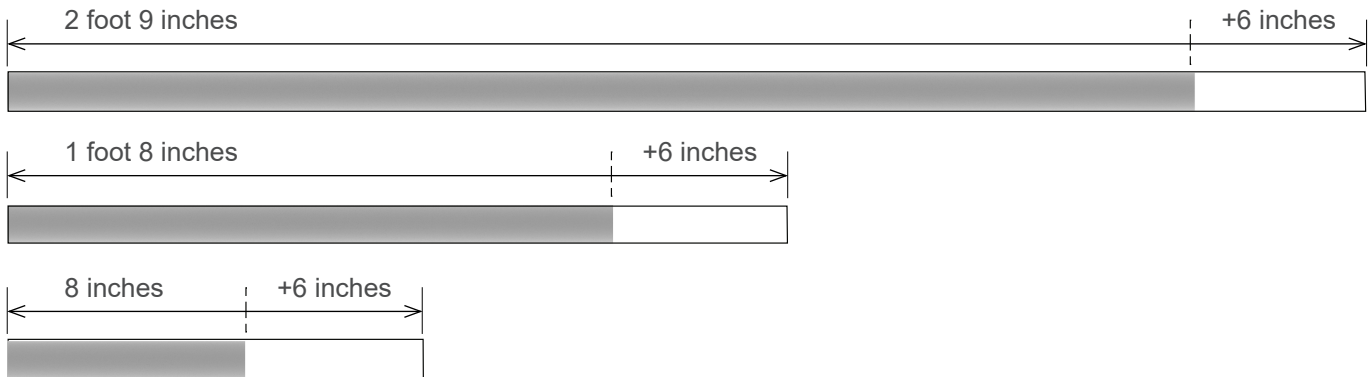
Place the Base Feet at the marked locations and secure in place with a Lag Bolt (3A). Cover the inside of the Base Feet with 1/2" bead of sealant (3B). Cover the surface of the inside of the base foot for a complete, waterproof seal.



STEP 3: INSTALL MECHANICAL TUB-

1. CUT TUBING TO LENGTH

While the Base Feet are being installed, cut the Mechanical Tubing to the heights specified in the project plan set, plus 6 inches. Use a band saw for this cut. In this instance we will use 8 inches, 1 foot 8 inches, and 2 feet 9 inches as our standard Mechanical Tubing measurements.



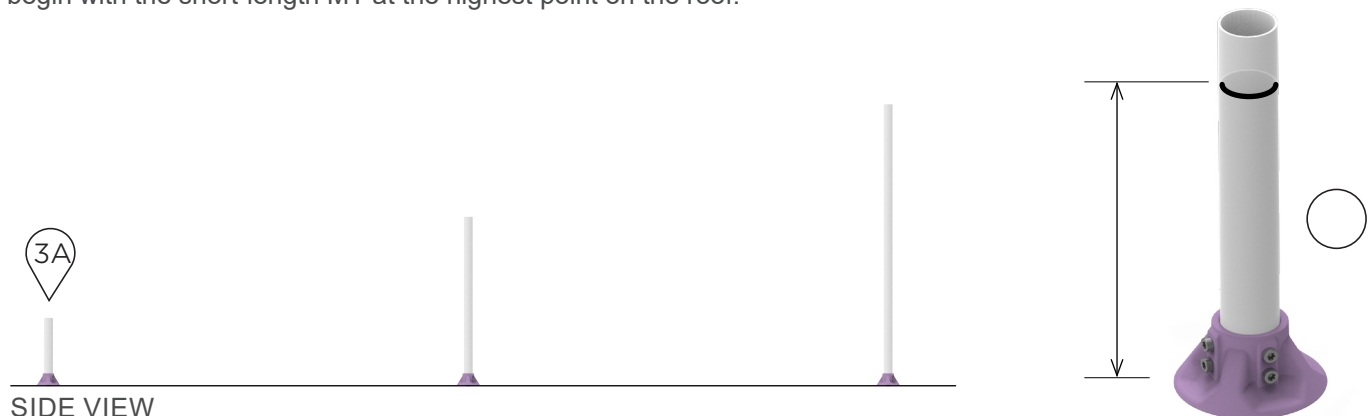
2. MOUNT TO BASE FEET

Insert the Mechanical Tubing into the Base Feet (2A) and fasten the Base Feet Set Screws (2B). Apply sealant between the Base Foot and Mechanical Tubing (2C).



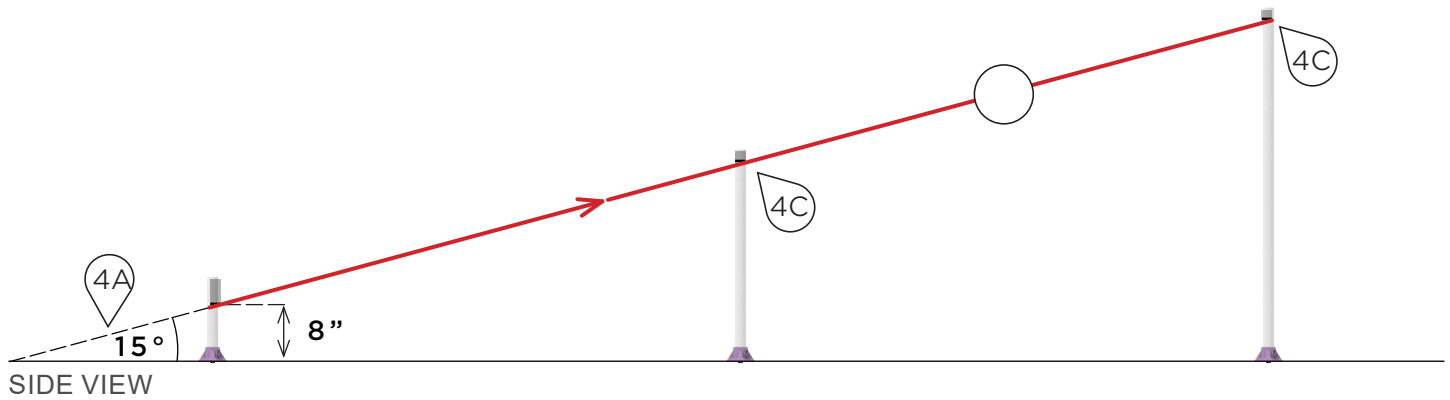
3. MARK HEIGHT OF SHORTEST LENGTH MECHANICAL TUBING

Select the starting Mechanical Tubing (3A), which will be a short-length Mechanical Tubing at the highest elevation on the roof. Use a Measuring Tape to measure out the height specified in project plan set (3B). In case of uneven roof surfaces, begin with the short-length MT at the highest point on the roof.



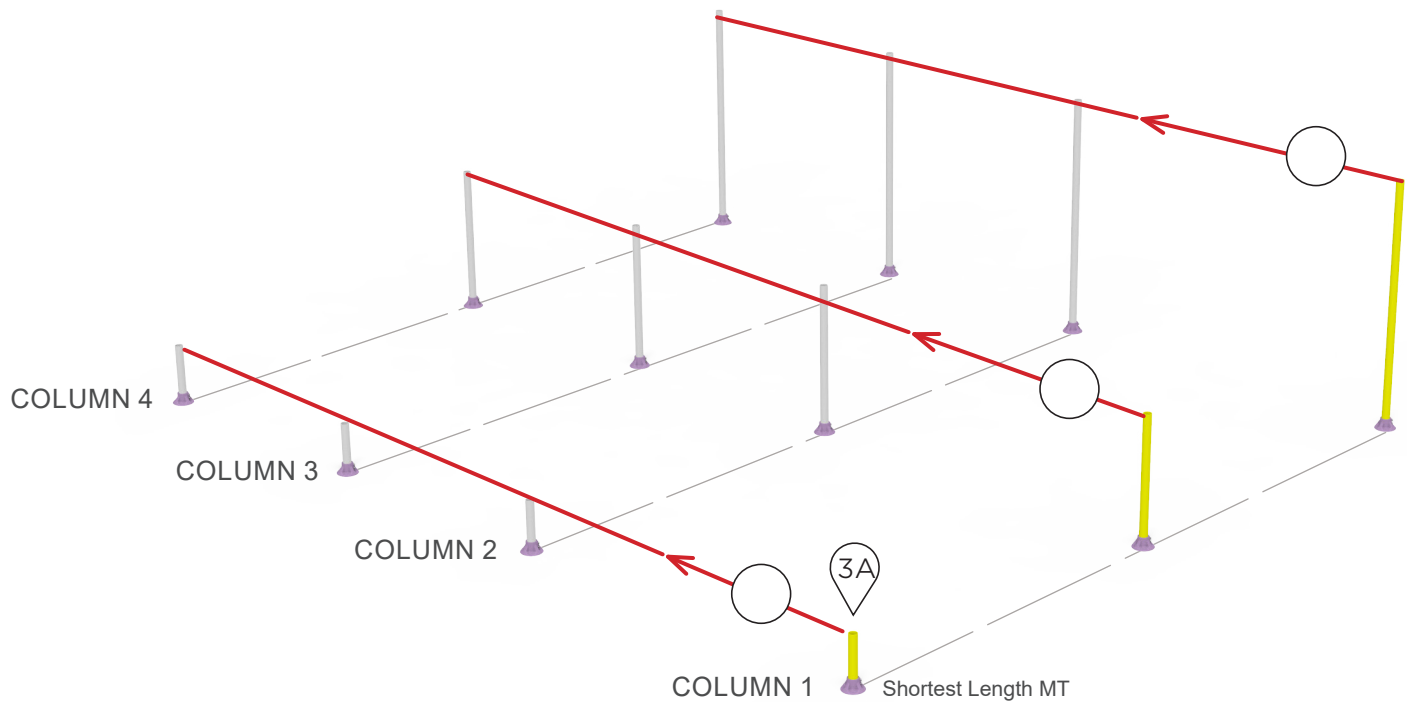
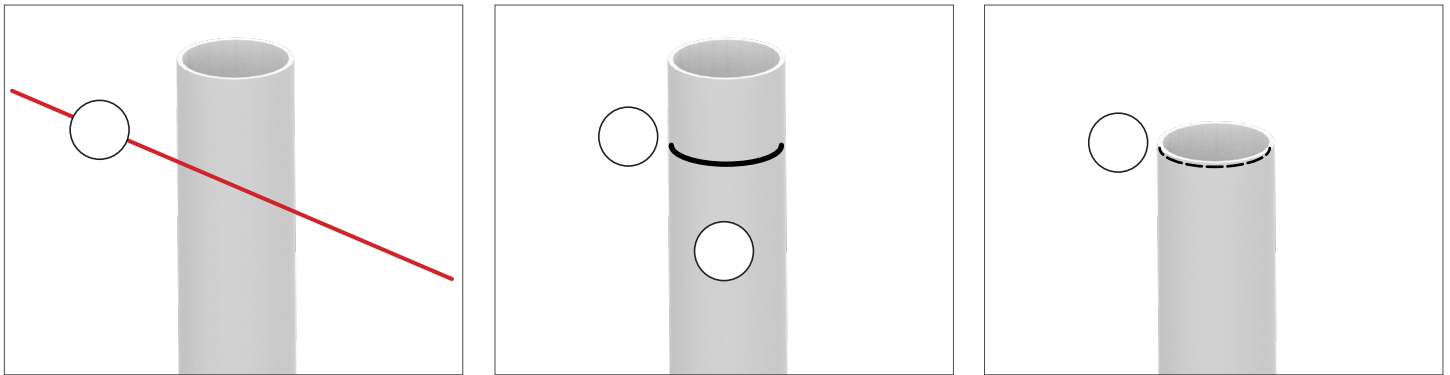
4. MEASURE AND MARK SLOPE OF FIRST COLUMN

Use a Protractor (4A) and String Line (4B) to measure the slope of the first column according to the slope specified in the project plan set, then mark the Mechanical Tubing (4C) in this column.



5. MATCH OTHER COLUMNS

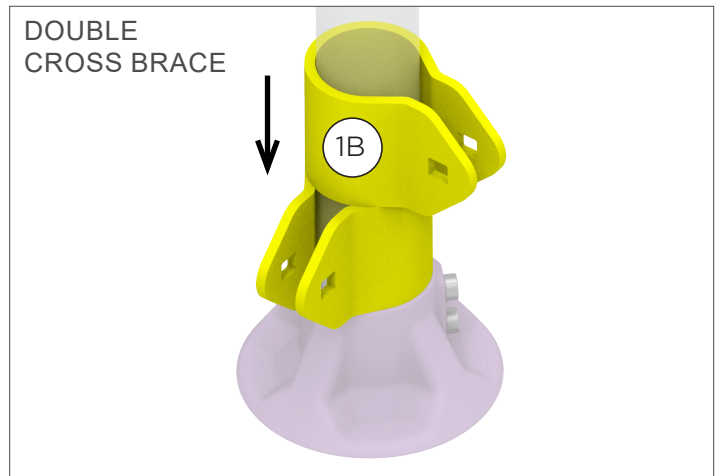
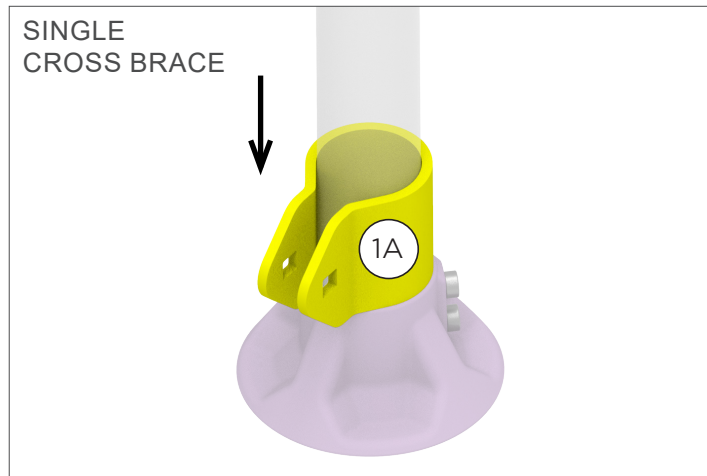
Use a String Line and Line Level to mark remaining columns of MTs at same height as the first column (5A). Use a Protractor to verify the slope of the each individual columns (same as step 4) according to the project plan set. Make adjustments as needed (5B), then cut all Mechanical Tubing (5C).



STEP 4: INSTALL BRACKETS, RAILS AND POST

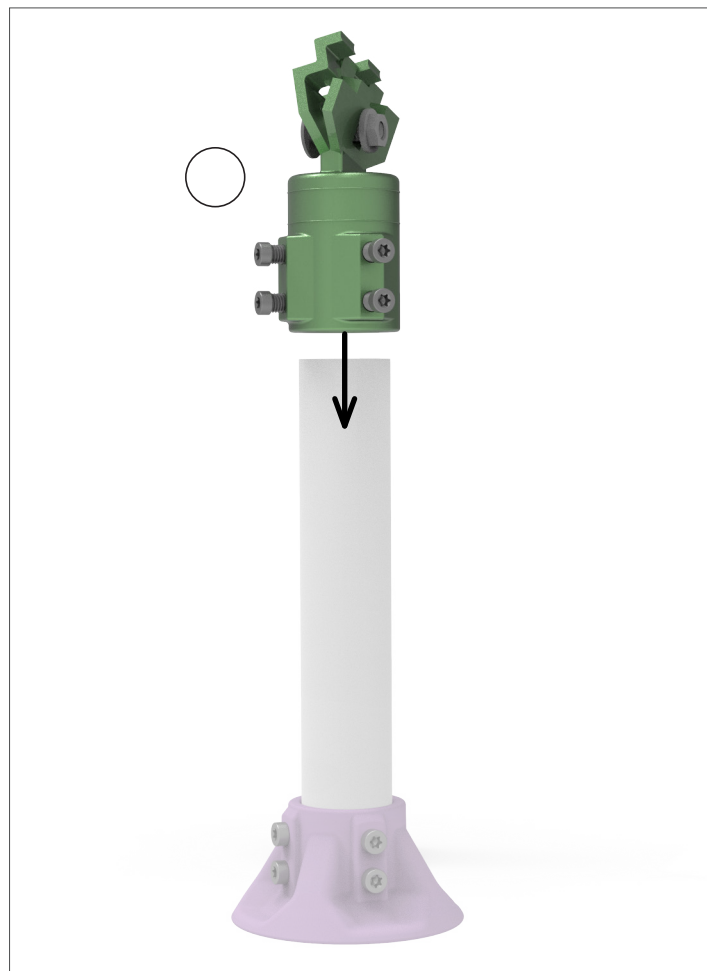
1. INSTALL CROSS BRACE BRACKETS

Set Cross Brace Brackets on MTs by sliding them onto the tubing. Single Cross Braces require 1 Cross Brace Bracket (1A). Double Cross Braces (with both North-South AND East-West) require 2 Cross Brace Brackets (1B).



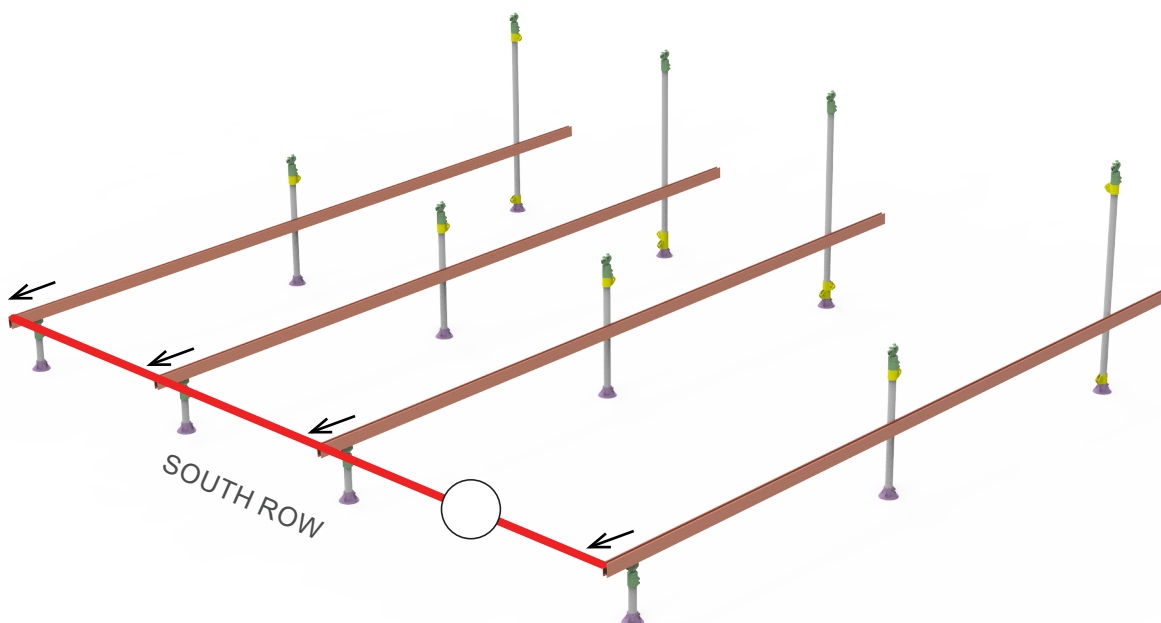
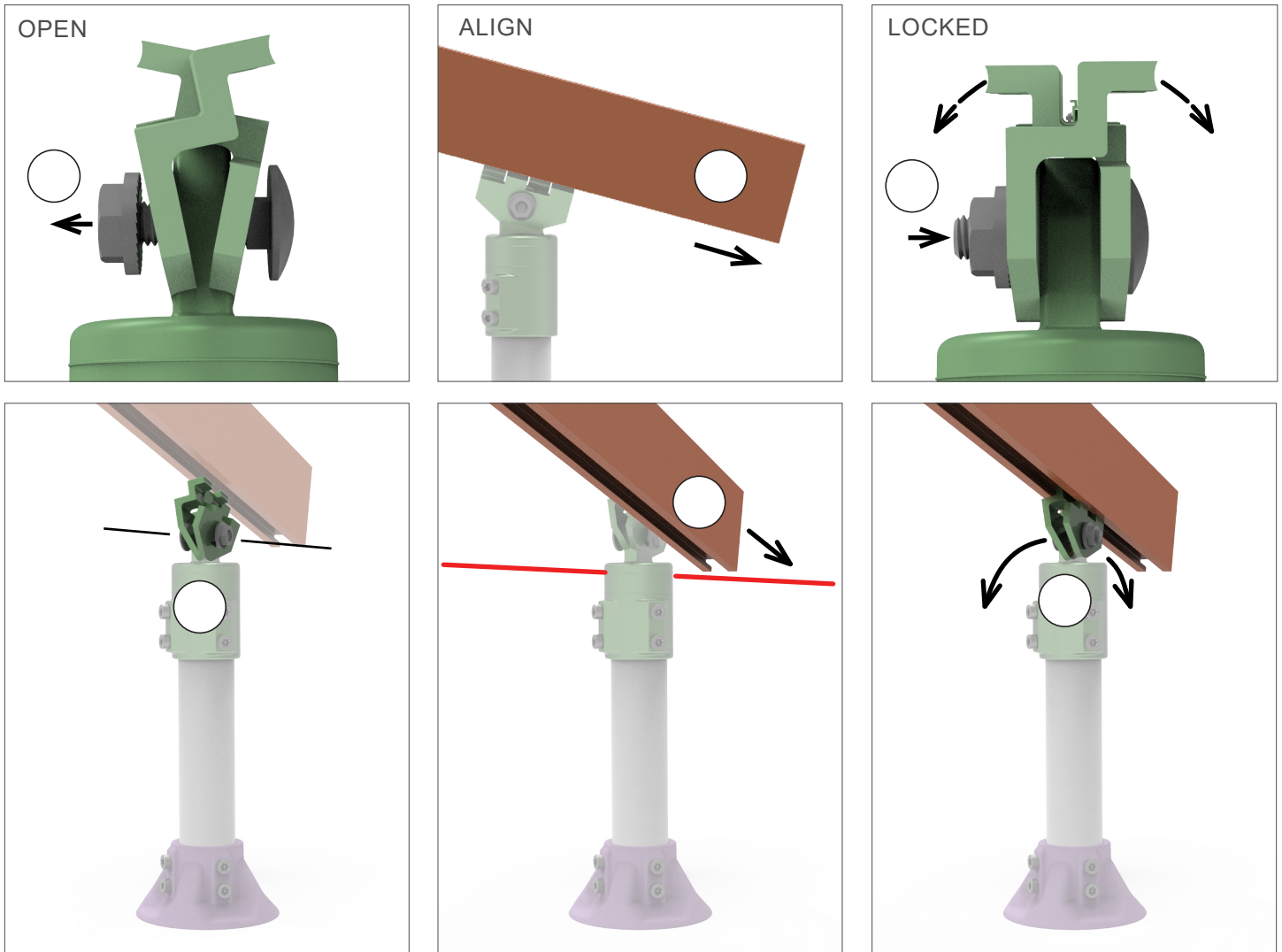
2. INSTALL POST MOUNTS

Set Post Mounts on all Mechanical Tubing (2A). Do not fasten the Post Mounts (2B).



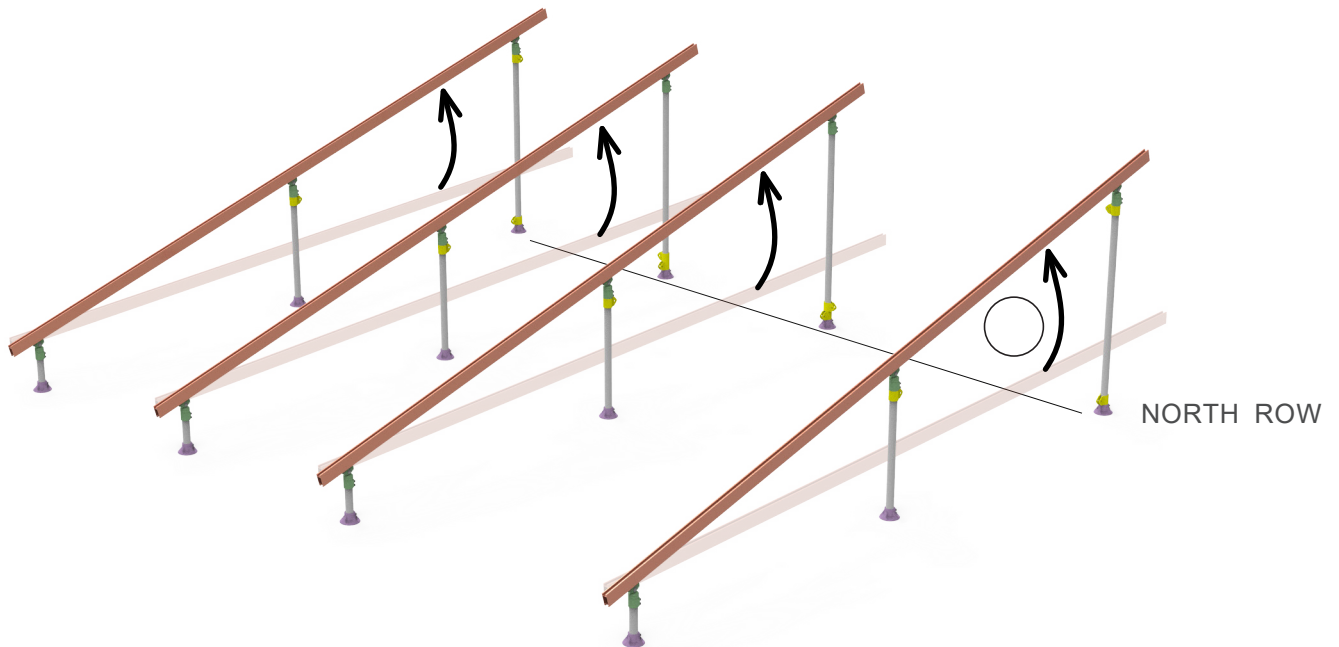
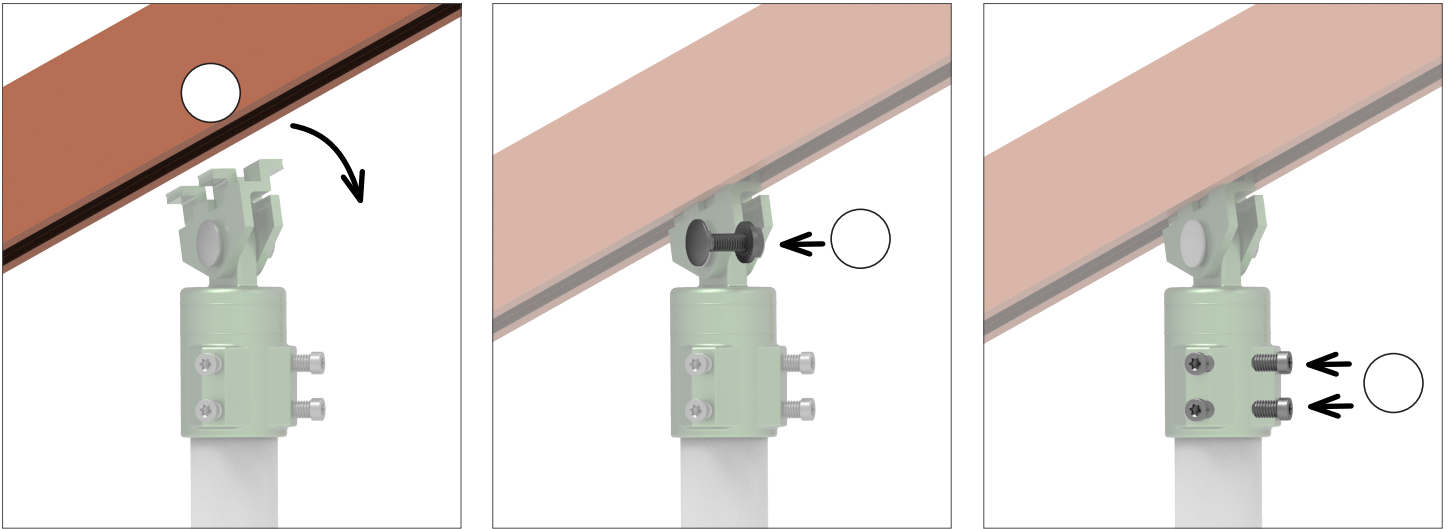
3. INSTALL RAILS ONTO SOUTH ROW

To install Rails, partially fasten (3A) the bracket clamps on the south row of Post Mounts. Use a String Line to align the Rails (3B), Then fully secure the south row of Bracket Clamps (3C) using an Impact Driver.



4. INSTALL RAILS ONTO NORTH ROW

Raise the Rails (4A) onto the remaining rows of Bracket Clamps, adjusting the Post Mount heights as needed to achieve the slope specified in the project plan set. Fully fasten all Bracket Clamp (4B) and Post Mount fasteners (4C).

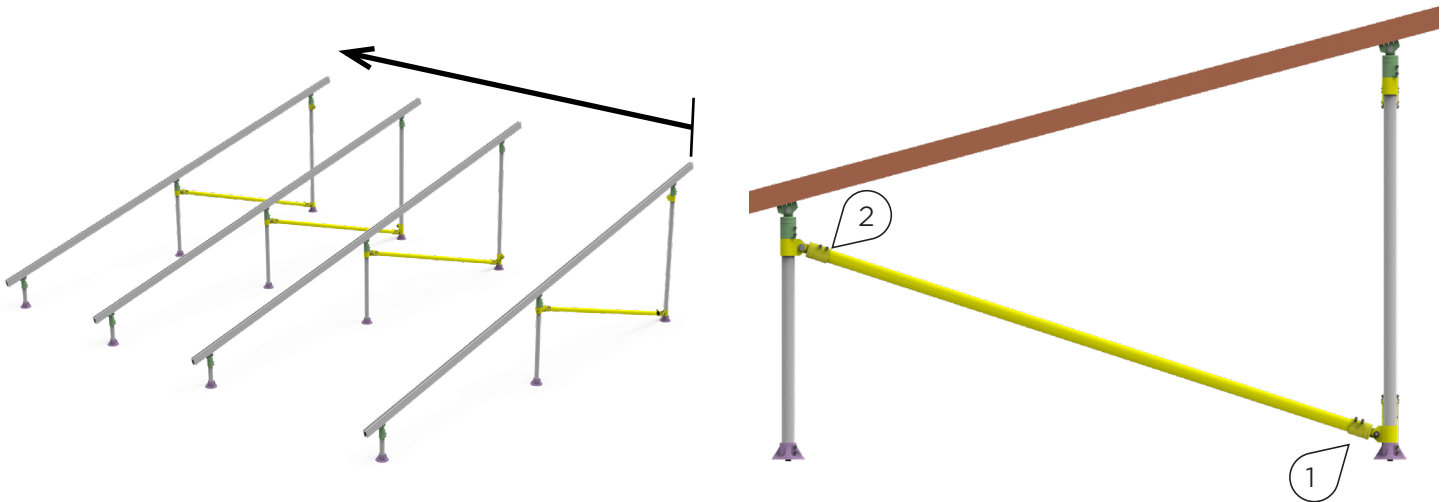


STEP 5&6: INSTALL CROSS BRACING (AS NEED-

Cross Bracing is installed along two axis, in the North-South and in the East-West orientation.

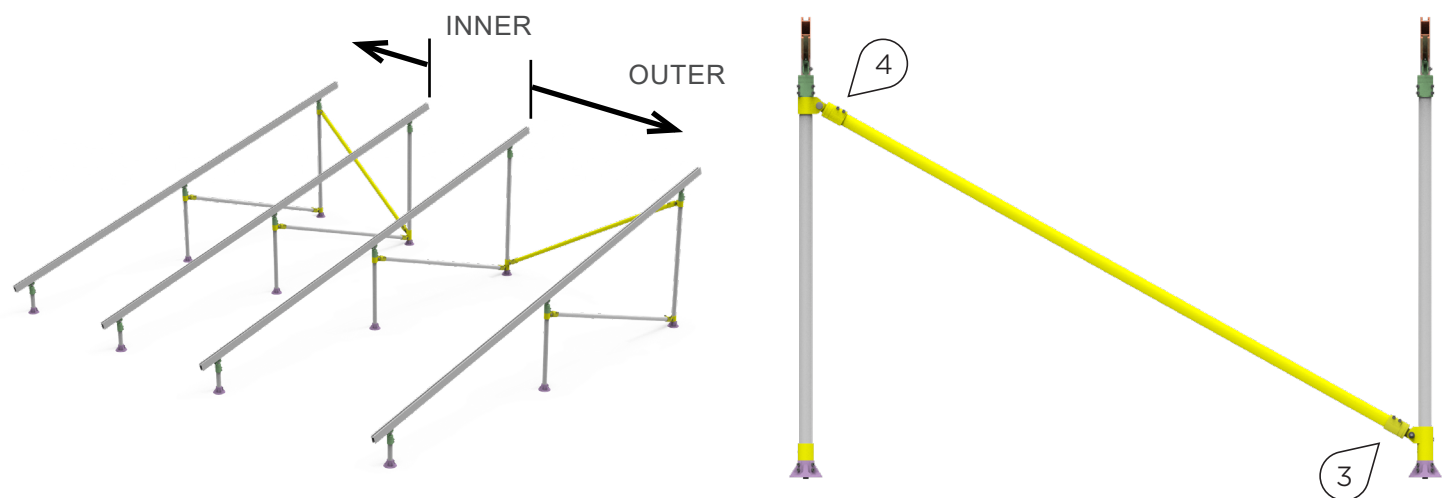
STEP 5: NORTH-SOUTH BRACING

If North-South Cross Bracing is required, it must be installed on every Rail. Refer to the project plan set for guidance. North-South Bracing is installed before East-West Bracing. The mounting sequence is at the lower end first (1), followed by the upper end (2). Install from one side to the other. Refer to the next page for detailed instructions.



STEP 6: EAST-WEST BRACING

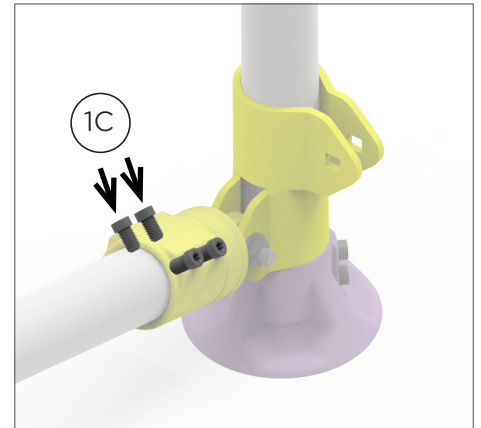
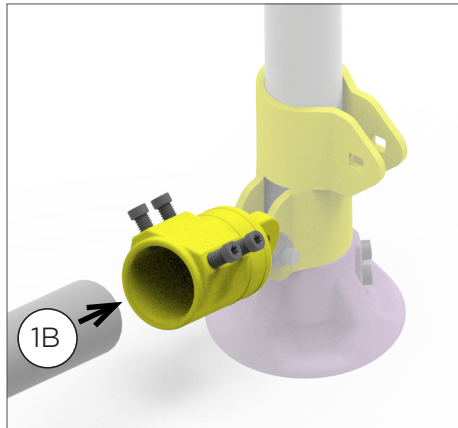
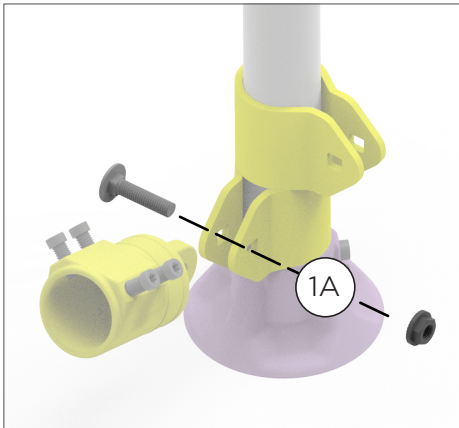
Refer to the project plan set for guidance on where to install East-West Cross Bracings. Begin installation at an inner row of MTs (3), followed by the outer end of the tubing (4). Use a Spirit Level to set the Outer Rail plumb. Refer to the next page for detailed mounting instructions.



STEP 5&6: INSTALL CROSS BRACING (AS NEED-

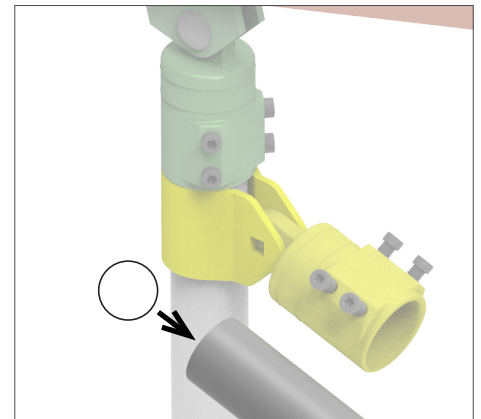
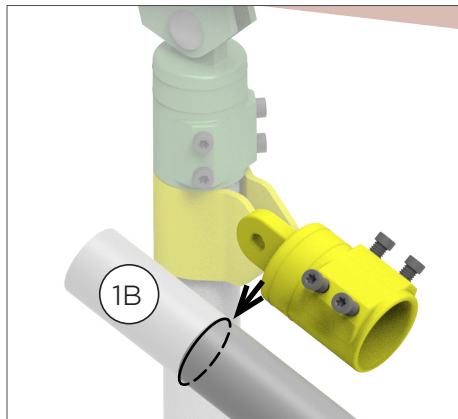
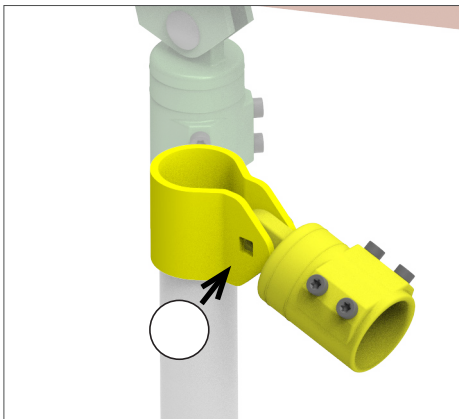
1. INSTALL LOWER END OF TUBE HEAD

Set and fasten a Tube Head at the first Cross Brace Bracket (1A) using an Impact Driver with a Socket. Then set (1B) and fasten (1C) an MT into the Tube Head using a Torx Bit.



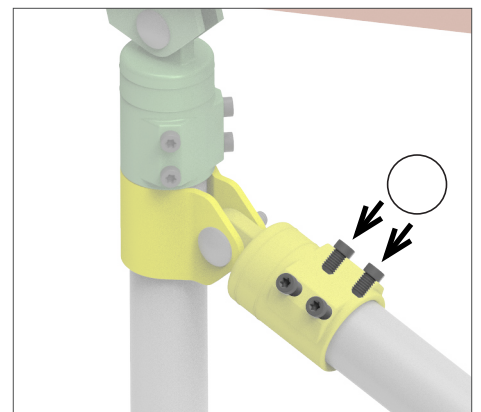
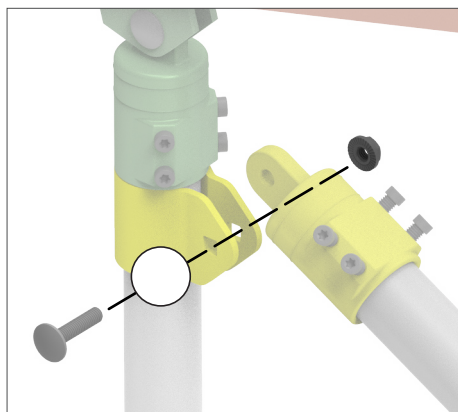
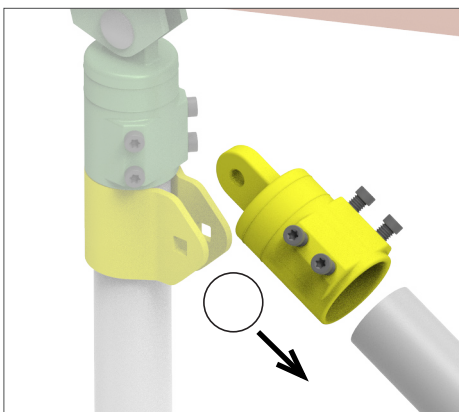
2. MARK AND CUT MECHANICAL TUBING TO LENGTH

Without fastening, set Tube Head into the Cross Brace Bracket (2A). Raise the MT up to the second Cross Brace Bracket and mark MT to length between Tube Head timing marks (2B). Cut MT to length (2C).



3. INSTALL UPPER END OF TUBE END

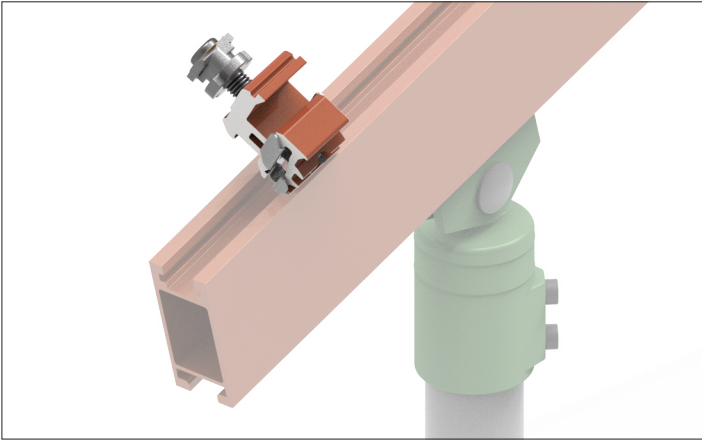
Fit Tube Head onto the MT (3A), then set Tube Head into Cross Brace Bracket to ensure proper fit, adjusting or modifying the MT as needed. Fasten all fasteners (3B, 3C).



STEP 7: FIRST ROW CAM

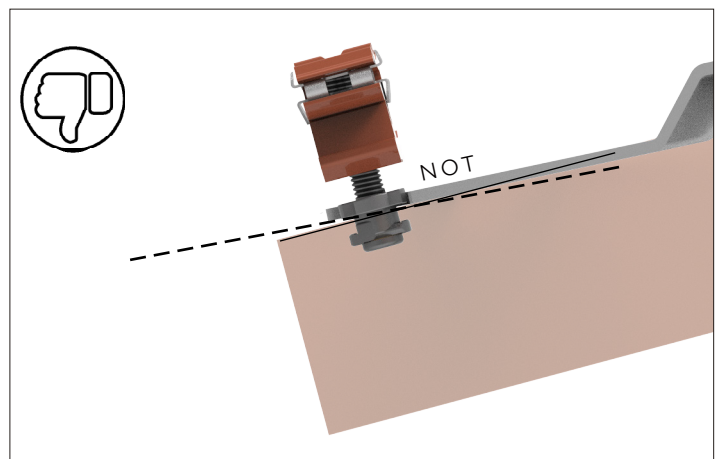
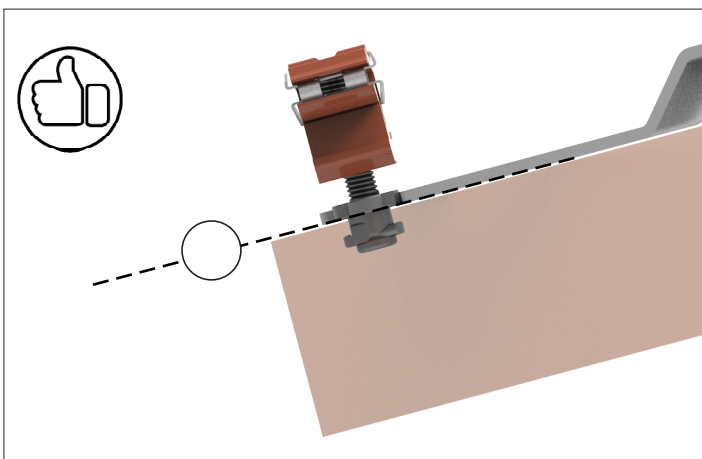
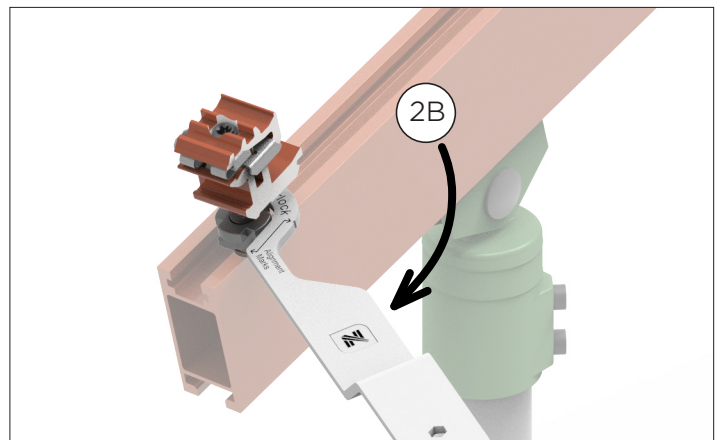
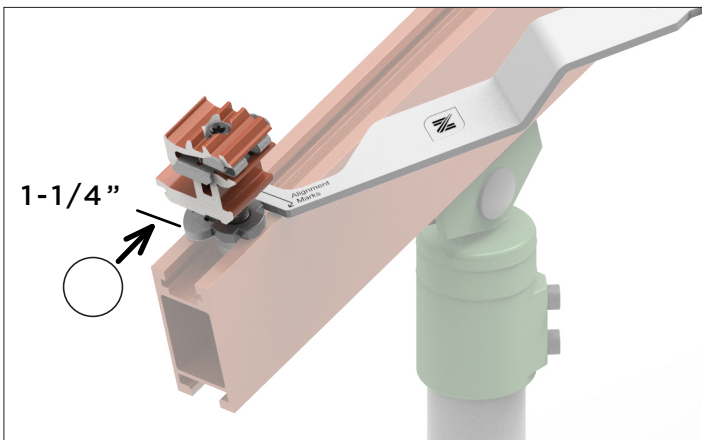
1. STAGE THE CAM FEET

Stage Cam Feet onto the Rails according to the number of modules specified in the project plan set by placing it Rockit-side down.



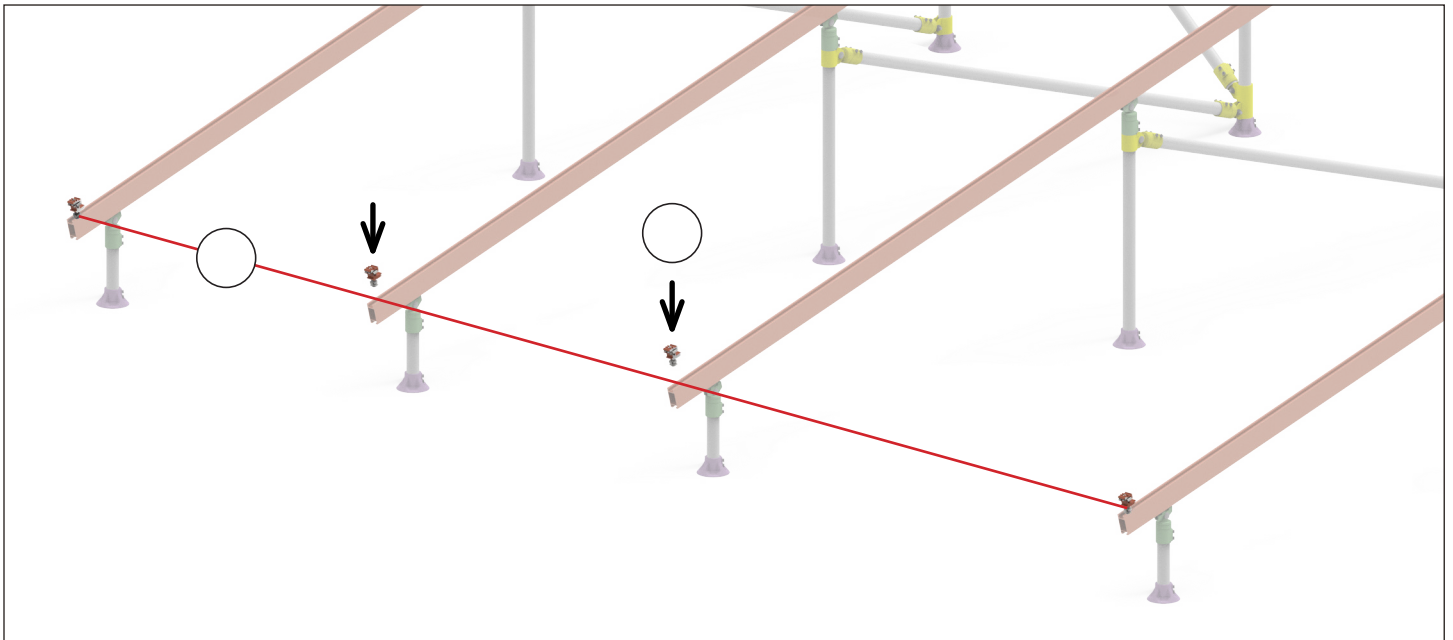
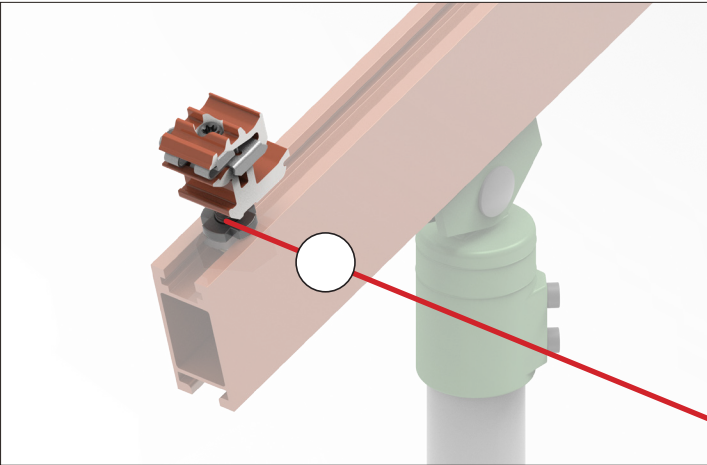
2. INSTALL **OUTER** CAM FEET FOR FIRST ROW

Insert the first Southern-edge Cam Foot into the Rail channel 1 1/4" from the Rail edge (2A). Use the Offset Flat Tool to turn the Cam Foot 90 degrees clockwise (2B). Keep Offset Flat Tool level and parallel to Rail surface to avoid gouging the Rail (2C). Install a Cam Foot on the opposite front corner, 1 1/4" from the Rail edge.



3. USE A STRING LINE TO INSTALL **INNER** CAM FEET

Pull a String Line (3A) between the corner Cam Feet to define the alignment of the first row and install the remaining Cam Feet (3B).



STEP 8: INSTALL FIRST ROW MODULES

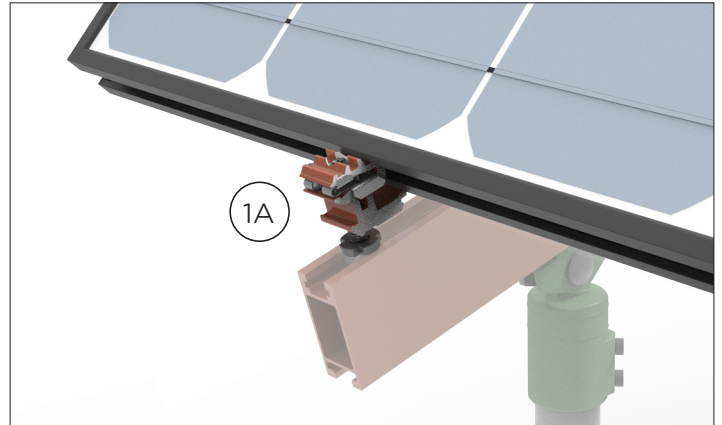
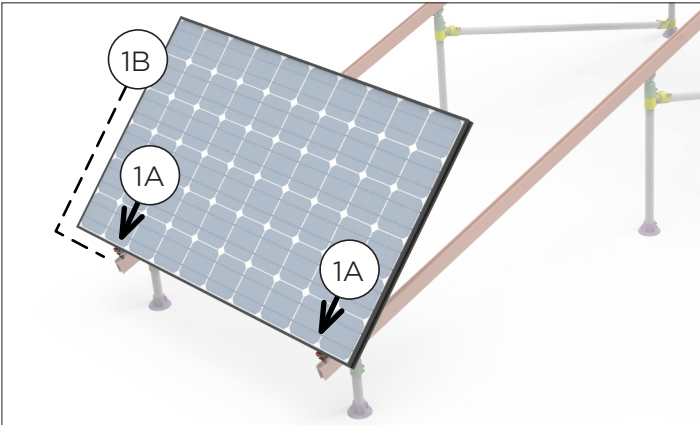
OPTION A: 2-POINT DROP IN (<4 FOOT SPAN)

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. A 2-point drop in installs the module onto two Cam Feet.

1. SET AND PARTIALLY ROCK DOWN THE MODULE

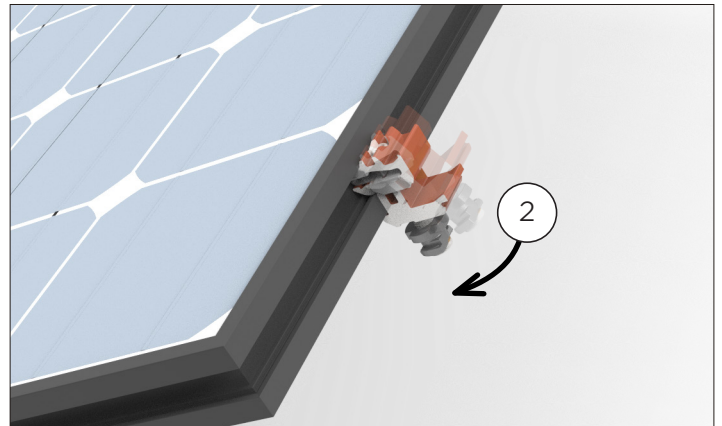
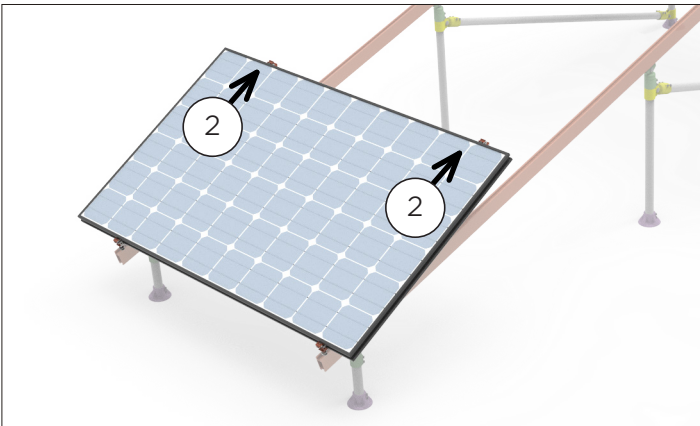
Set a module onto the Tongue side of the Cam Foot Rockits (1A). Align the module with the marked corner edge (1B).

Push while rocking the module down to ensure proper seating.



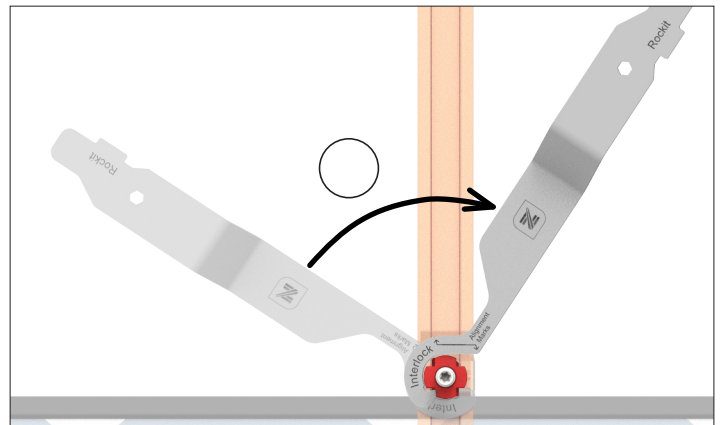
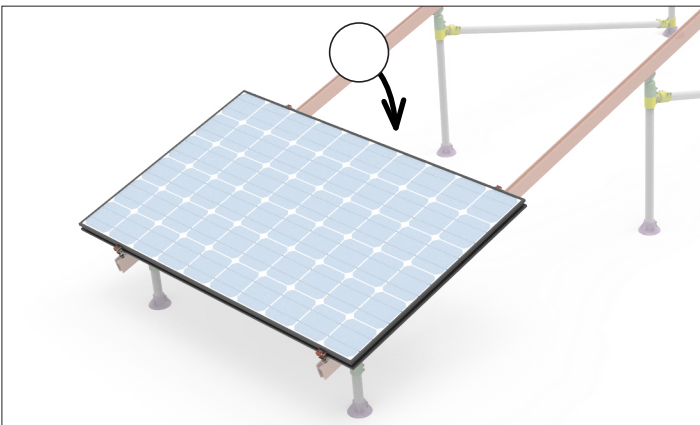
2. ROCK DOWN THE MODULE AND ENGAGE REAR CAM FEET

Before completely lowering the module, engage two Cam Feet at the back side of the module where they will meet their respective Rails.



3. FASTEN REAR CAM FEET

Fully rock the module down (3A). Insert the Cam Feet into their respective Rail channels and use the Flat Tool to secure them 90 degrees clockwise (3B).



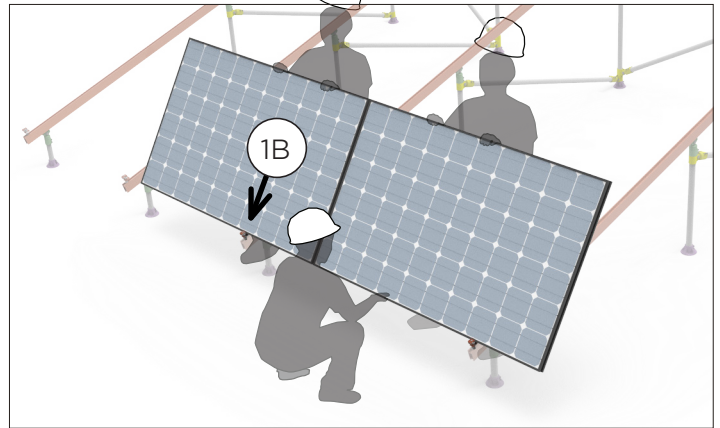
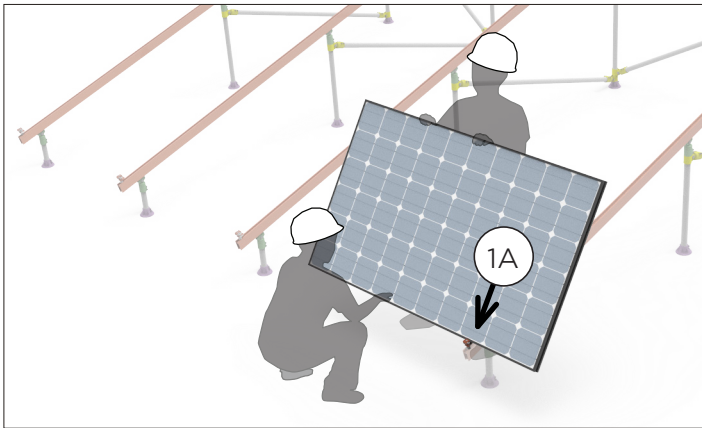
STEP 8: INSTALL FIRST ROW MODULES

OPTION B: 1-POINT DROP IN (>4 FOOT SPAN)

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. A 1-point drop in installs each module onto one Cam Foot.

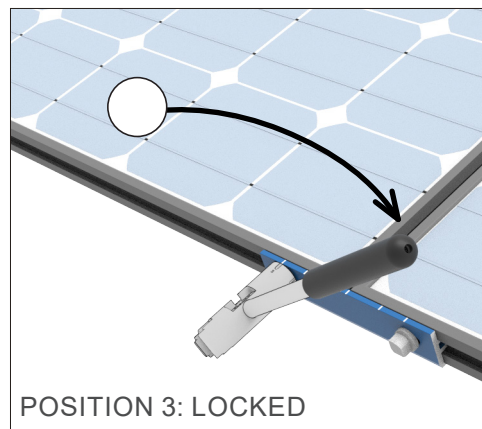
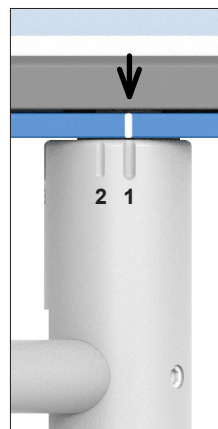
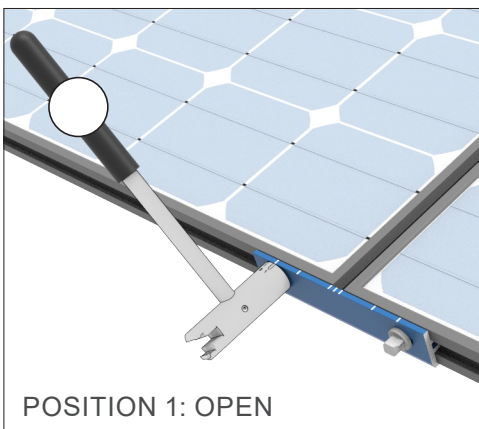
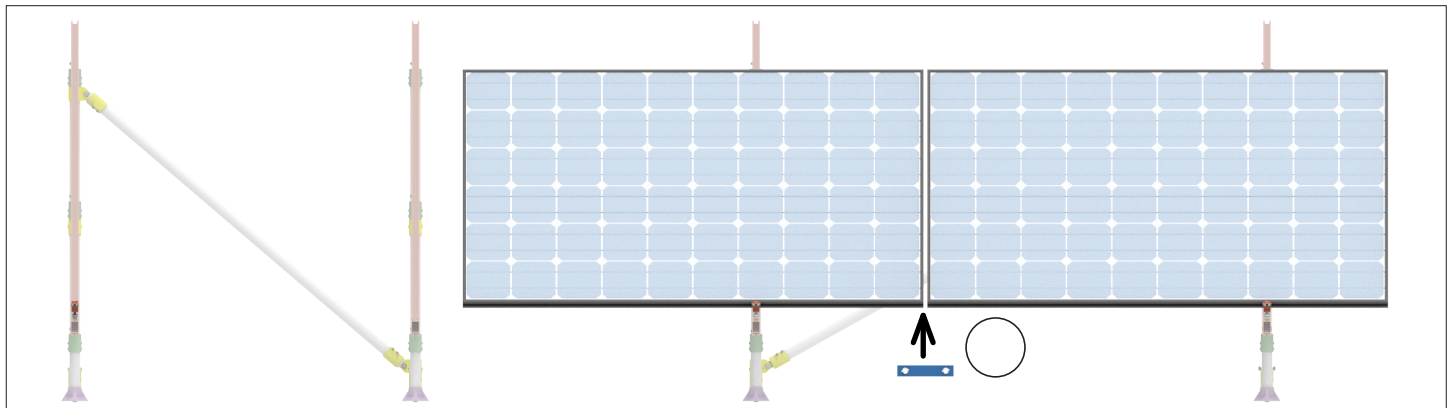
1. POSITION THE MODULES USING THREE INSTALLERS

Have the first installer lift up the first module onto a Cam Foot (1A) while a second installer provides support. Have a third installer lift up a second module onto its Cam Foot (1B) while the second installer provides support.



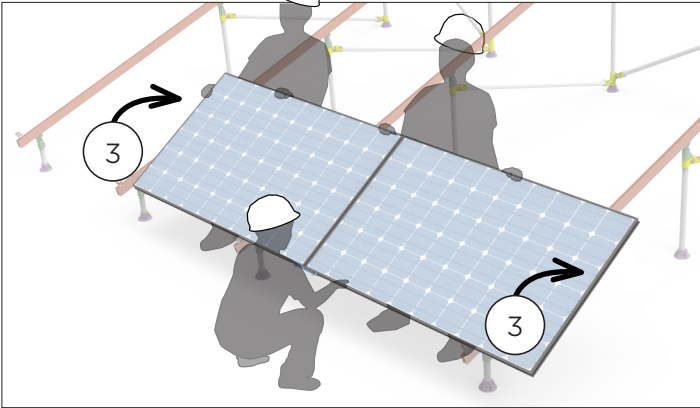
2. INSTALL FIRST ROW INTERLOCKS

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 (2A). Align the Interlock so that the edges of the modules fall on the appropriate timing marks. Use the Zep Tool to turn the Interlock Zep 90 degrees clockwise from Position 1 (2B) to Position 3 (2C) on the Zep Tool Timing Marks. This will lock the two modules together between the two drop in points. Install first row Interlocks



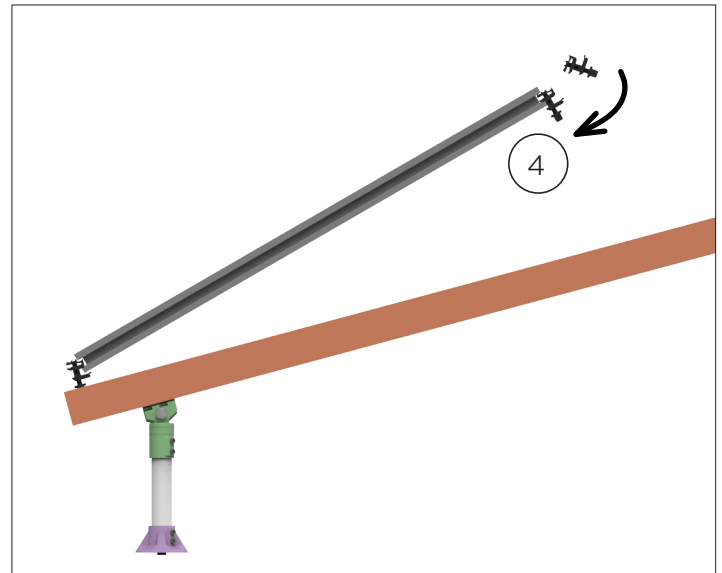
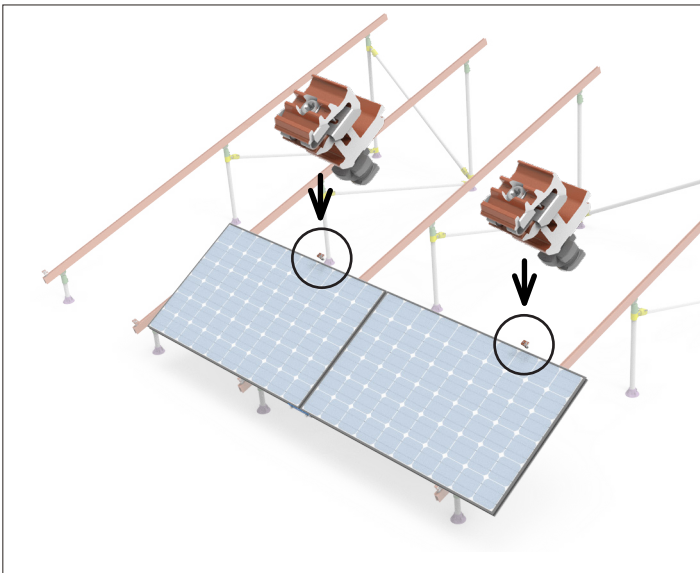
3. ROCK DOWN BOTH MODULES

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



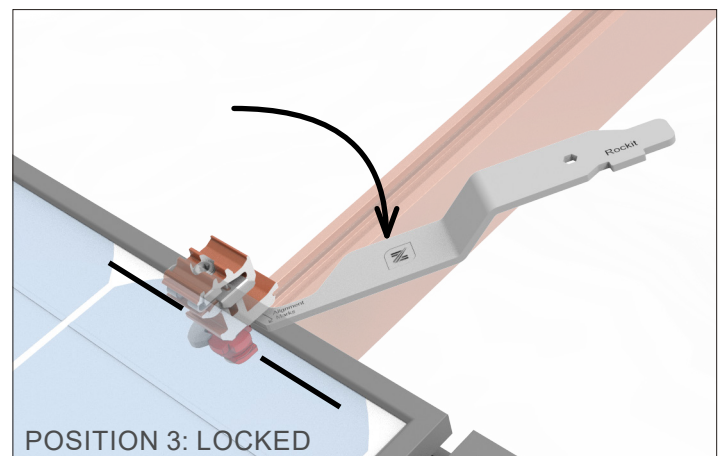
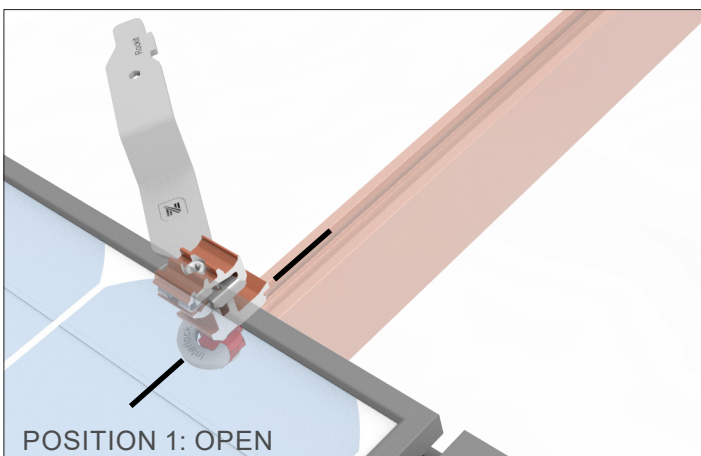
4. ENGAGE REAR CAM FEET

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



5. FASTEN CAM FEET

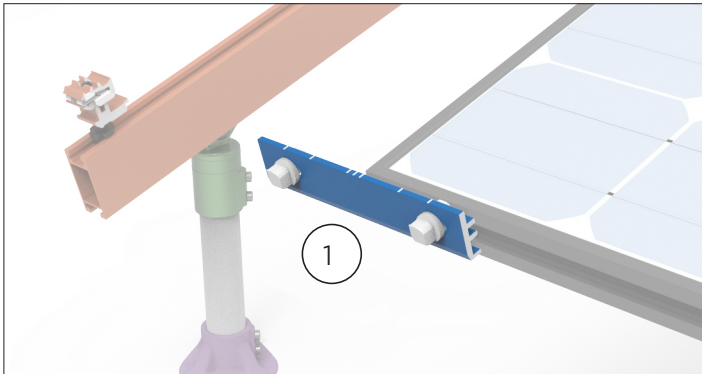
Use the Flat Tool to secure them 90 degrees clockwise. Once the Cam Foot Rockit is engaged in the module, turn the Cam Foot Nut 90 degrees to fasten into the Rail.



STEP 9: COMPLETE FIRST ROW MOD-

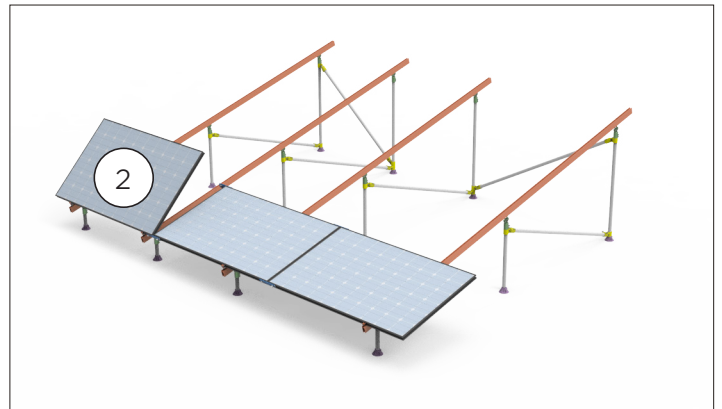
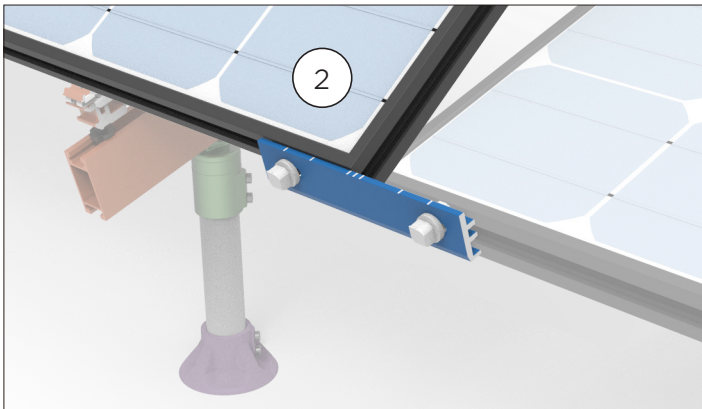
1. INSTALL INTERLOCK

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.



2. INSTALL MODULE

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.

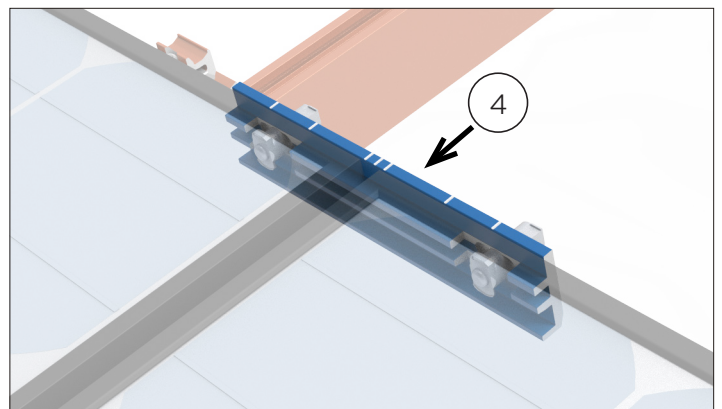
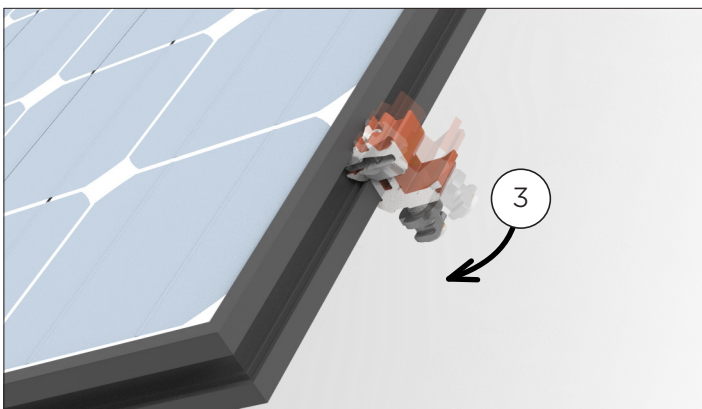


3. ENGAGE REAR CAM FEET

Before completely lowering the module, engage Cam Feet at the back of the module where they will meet their respective Rails. Fully rock down the module and secure the Cam Foot with the Offset Flat Tool.

4. INSTALL REAR INTERLOCK

Install an Interlock onto the back of the two modules.

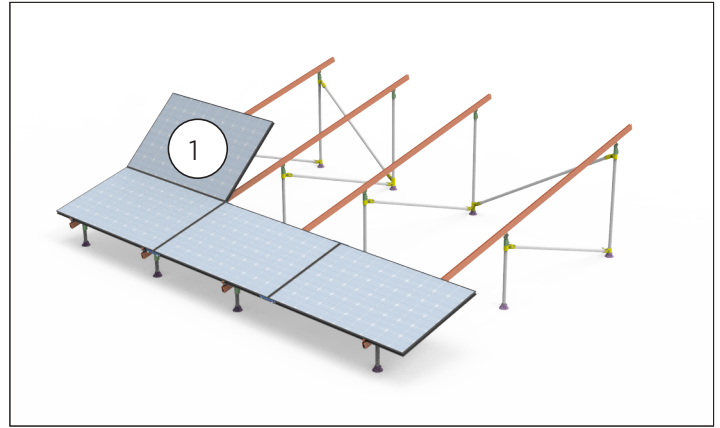
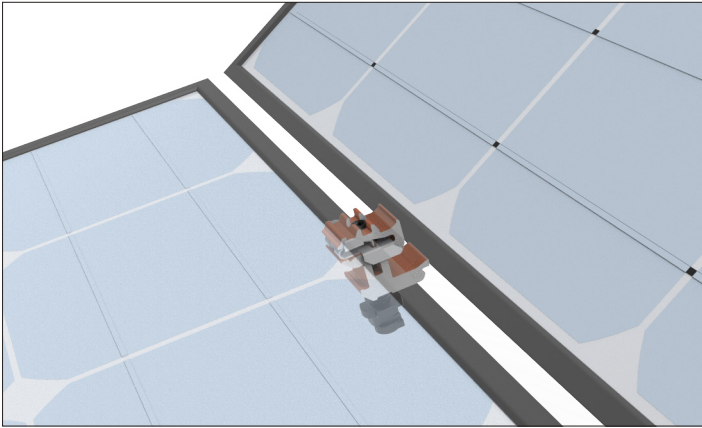


5. REPEAT UNTIL ROW IS COMPLETE

STEP 10: COMPLETE REMAINING MODULES

1. ROCK IN MODULE

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.

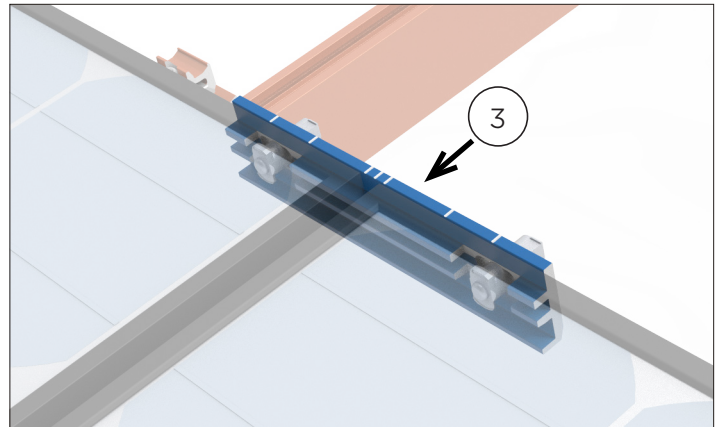
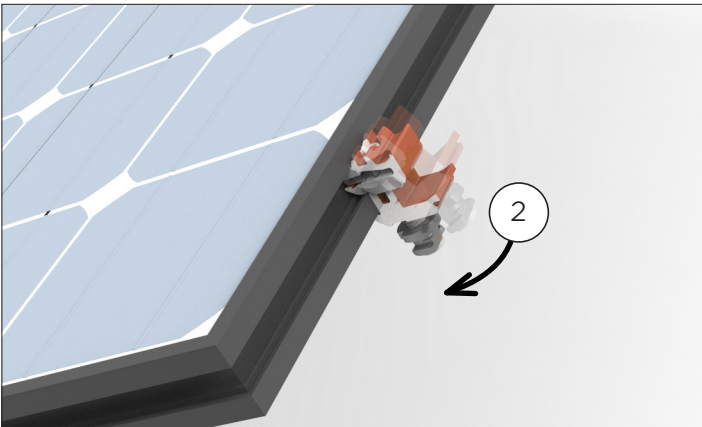


2. ENGAGE AND SECURE CAM FEET

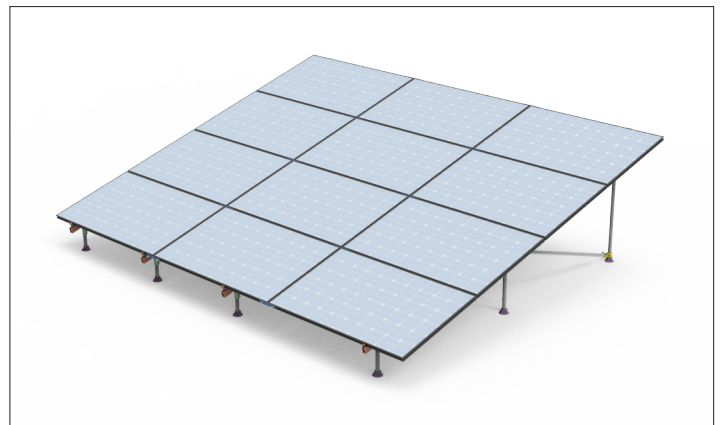
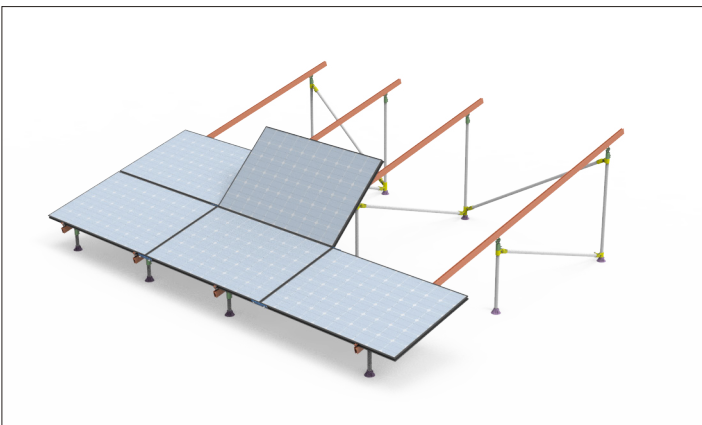
Before completely lowering the module, engage Cam Foot(s) at the back of the module where it will meet its respective Rail. Fully secure the Cam Foot(s).

3. DROP IN THE NEXT MODULE AND INSTALL INTERLOCK

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



4. REPEAT UNTIL THE ARRAY IS COMPLETE

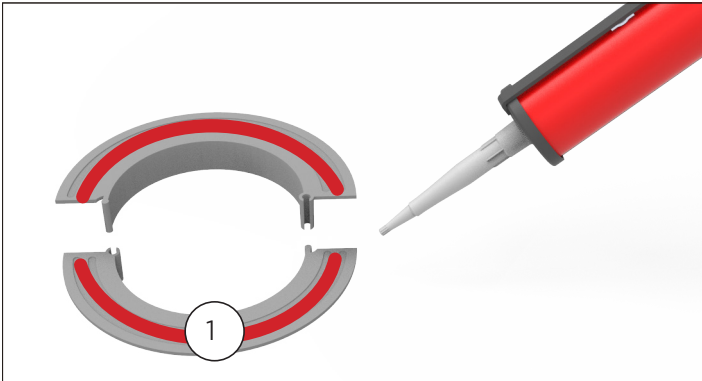


STEP 11: INSTALL SEALING RING

The **Sealant Ring** serves as a waterproofing dam at the base of a positive roof attachment. The Sealant Ring is used with solar arrays installed on low-slope residential roofs. Sealant Ring **MUST** be installed on a clean roof surface.

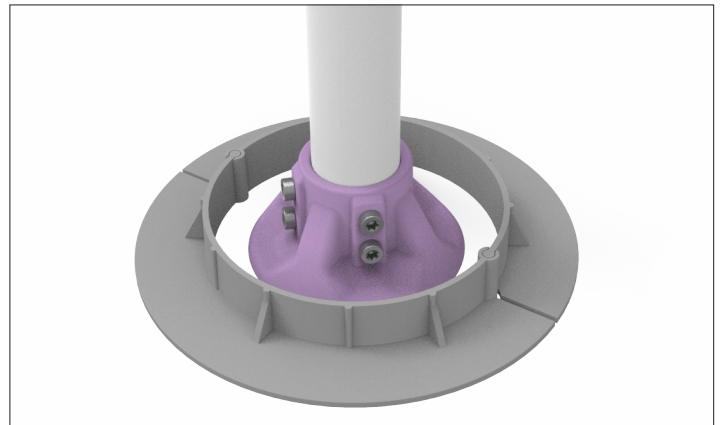
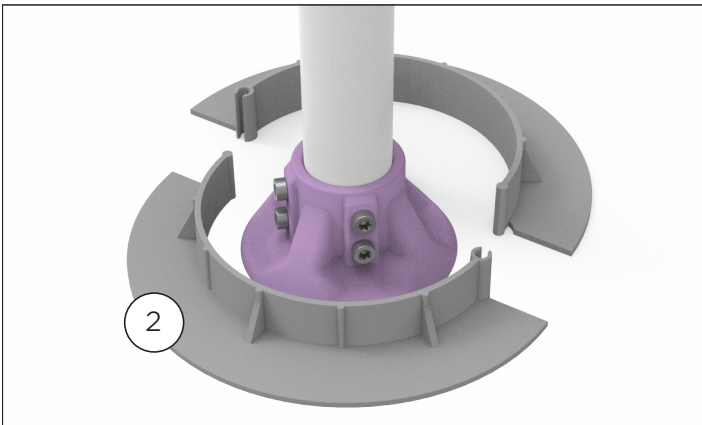
1. APPLY SEALANT

Apply a bead of Sealant on the bottom of each half of the Sealant Ring.



2. INTERLOCK TWO HALVES OF THE SEALANT RING

Set each half of the Sealant Ring around the Base Foot, interlocking the joints of both halves.

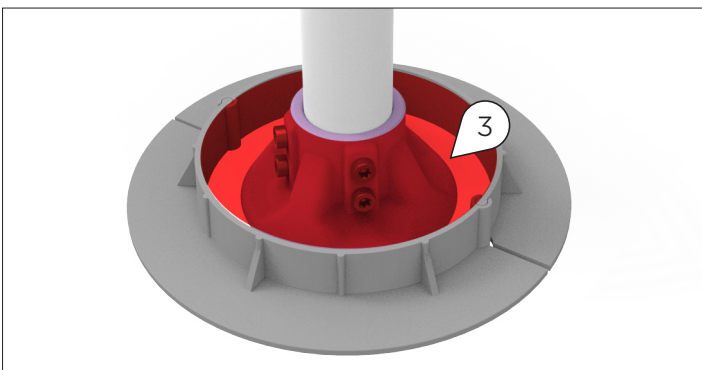


3. OPTION A: POURABLE SEALANT

On roofs with a pitch of 1:12 or less, apply Sealant to all surfaces with potential water infiltration as indicated below. Fill the Sealant Ring with Pourable Sealant. Do not overfill Sealant Ring.

OPTION B: HIGH VISCOSITY SEALANT

On roofs with a pitch greater than 1:12 and up to 2:12, apply Sealant to all surfaces with potential water infiltration. Fill the Sealant Ring with High Viscosity Sealant.



APPENDIX: ALLOWABLE MOUNTING SYSTEM LOADING

Tesla Compatible modules have been evaluated for design loads on the back surface (e.g., wind load) and on the front surface (e.g., wind and snow load).

UL 2703 REQUIREMENTS

PV Modules were evaluated at the following attachment spacings in order for Tesla Solar hardware to obtain load ratings using specified test procedures.

ZS RAMP				
MODULE	LANDSCAPE		PORTRAIT	
	ATTACHMENT SPACING	LOAD (PSF)	ATTACHMENT SPACING	LOAD (PSF)
Tesla T###S where ### = 420, 425, 430	24"	50 - front side; 50 - rear side	24"	16.7 - front side; 37.5 - rear side
Q.Cells Q.Pro-G4 where ### = 250-265	24"	50 - front side; 50 - rear side	24"	50 - front side; 50 - rear side
Q.Pro-G4.1 where ### = 270-325				
Q.Peak Duo BLK G5 where ### = 310-320				
Q.Peak Duo BLK G6+ where ### = 330-345				
Q.Peak Duo BLK ML-G10+/TS where ### = 395-415	24"	50 - front side; 50 - rear side	24"	16.7 - front side; 37.5 - rear side

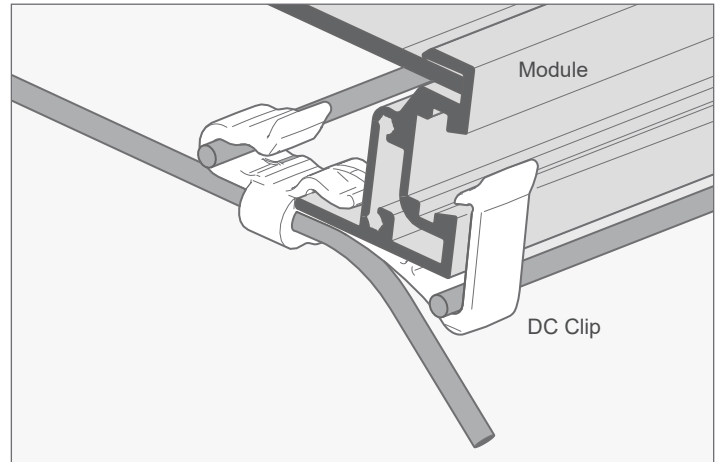
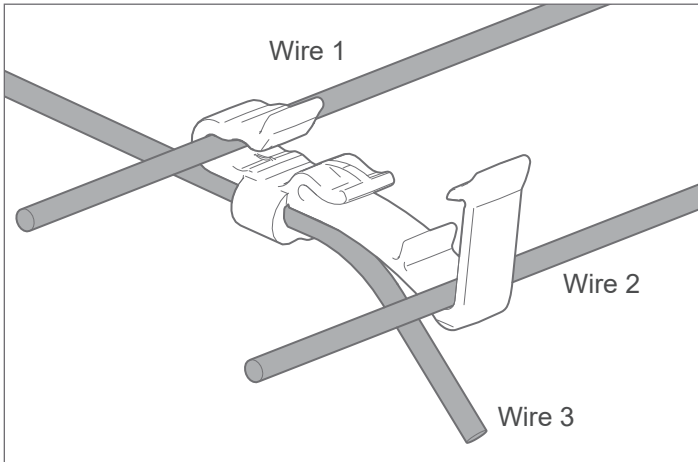
*all spacings are measured on center.

Tesla Solar Hardware must be installed following all applicable instructions.

Listed by UL to UL 2703 for a mechanical load rating up to 50 psf downforce and up to 50 psf uplift. This racking system is Listed for fire performance, grounding and mounting of Listed PV modules where the combination of Listed module and Listed racking system has been evaluated.

APPENDIX: WIRE MANAGEMENT RECOMMENDATIONS

Perform wire management as appropriate for the array. Refer to the example below for a standard 3x3 module array. The DC Wire Clip (Part No. 850-1509) is UL listed to UL 1565 as a Wire Positioning Device. DC Wire Clip accommodates up to three wires.

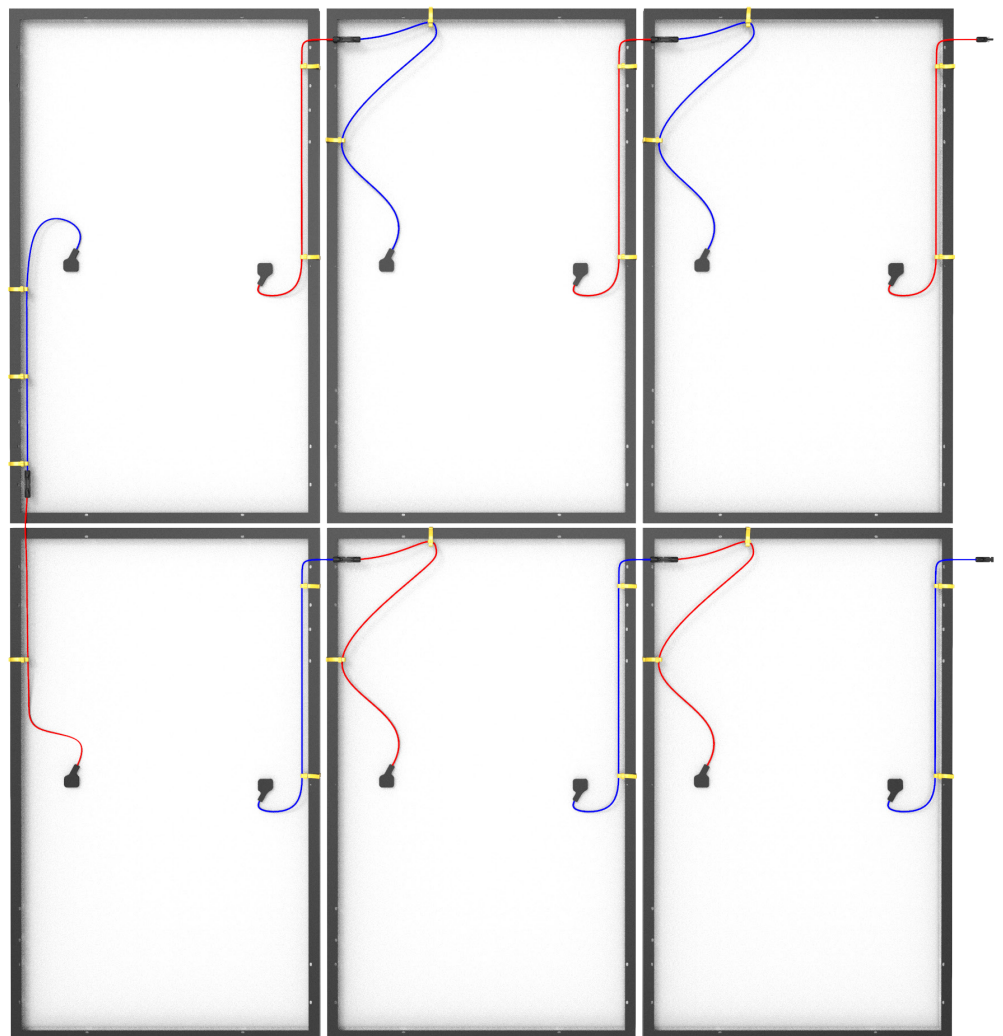
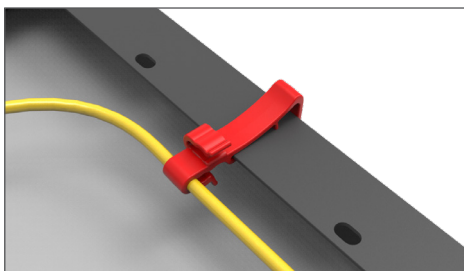


EXAMPLE ARRAY WIRING: PORTRAIT



Ensure that the cabling is not under mechanical stress (Comply with bending radius of ≥ 2.36 in (60 mm)).

Ensure that the cables do not run between module and mounting rail or structure (danger of pinch).



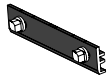
APPENDIX: GROUNDING AND BONDING

INTERLOCK ROCKIT GROUND ZEP

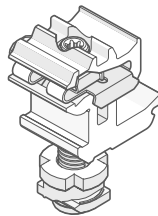
Tesla Zep Compatible™ systems do not require running copper conductors to each module. The act of physically installing each component simultaneously establishes an electrical bond.

Adjacent Tesla Zep Compatible™ module frames are bonded using two Tesla Solar products. The frame of every module is electrically bonded to adjacent modules and/or Array Skirts through the Interlock and Cam Foot. The frame of every module is part of the EGC path. The EGC path leaves the array by means of the Ground Zep connected to a copper conductor, which acts as the fault current path to ground. The face of the Ground Zep is labeled “GND.”

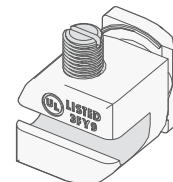
Interlock



Rockit (Cam Foot V2)

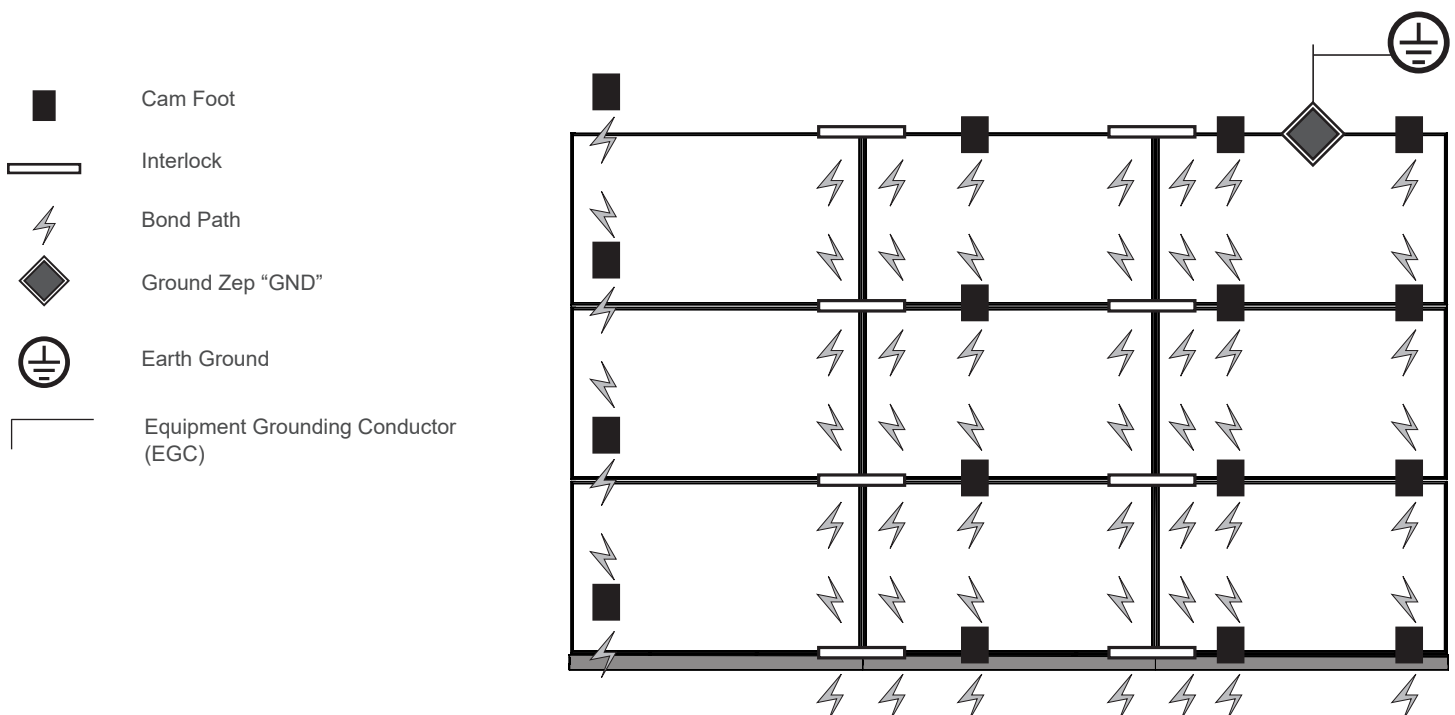


Ground Zep “GND”

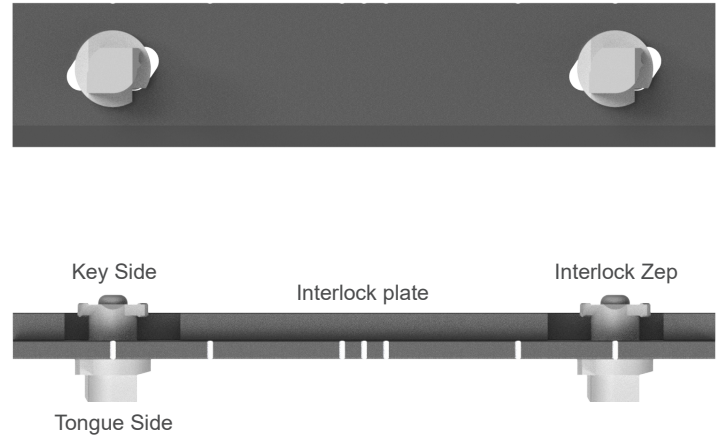
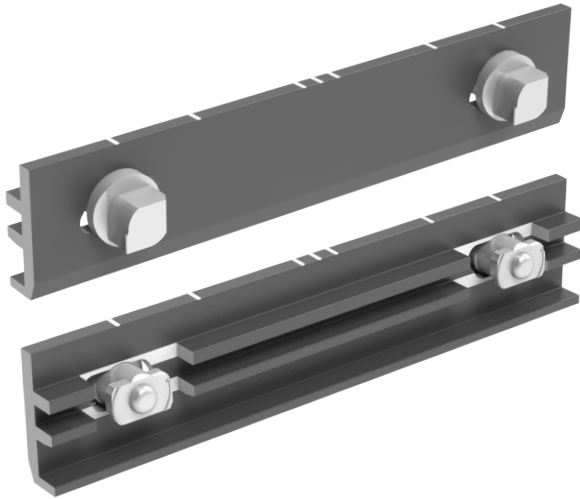


The following example shows a representative fault current ground path leaving a Tesla Zep Compatible™ array. Each Interlock and Cam Foot creates a bond between the module(s) and Array Skirt(s) it touches. The EGC path is carried through each module frame and Array Skirt. The fault current ground path then leaves the array through the Ground Zep. Typical Tesla Zep Compatible™ arrays will have multiple EGC paths, represented by the bond symbol below.

In the event a module must be removed for servicing, use additional Ground Zeps as needed to ensure the ground bonding path is maintained.



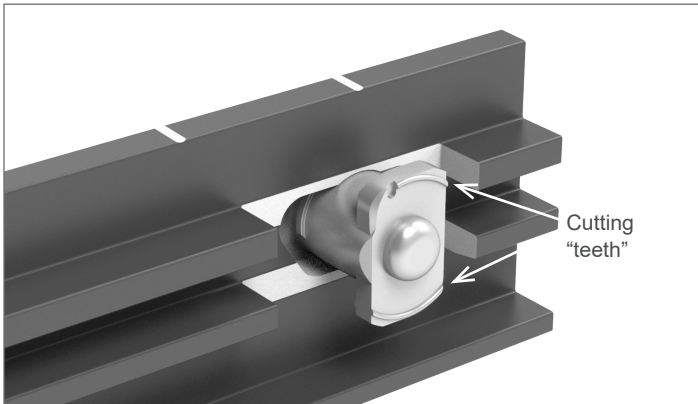
INTERLOCK



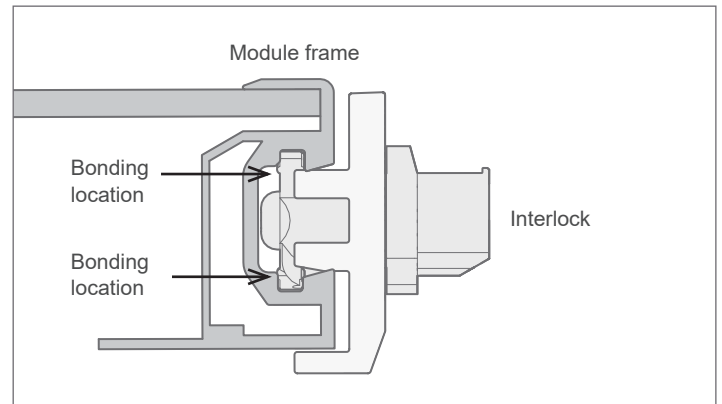
KEY SIDE BONDING TO MODULE FRAME

Forced interference during rotation of Interlock Zep causes teeth to cut through anodization on module frame, resulting in robust and UL certified bonding path.

Key Side in closed position



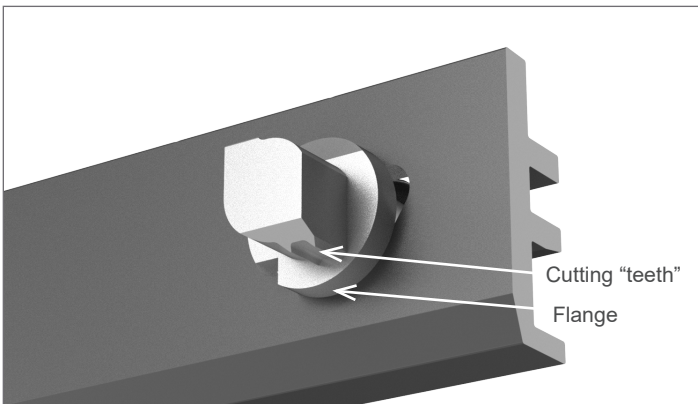
Side View



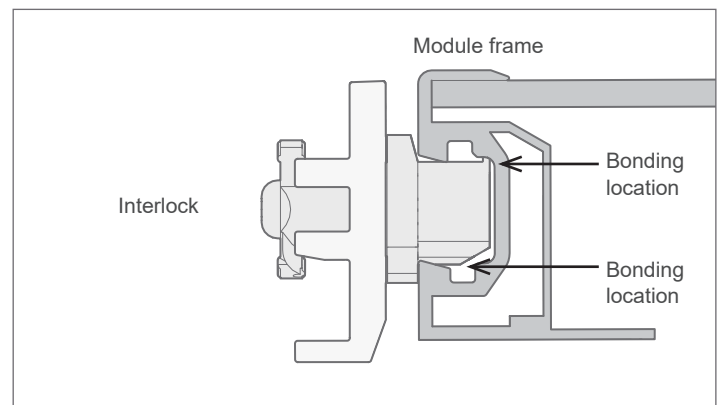
TONGUE SIDE BONDING TO MODULE FRAME

Forced interference between mating parts from module rock-in motion cuts into module frame for the range of allowable install positions, removing anodization and resulting in robust and UL certified bonding path.

Tongue Side in closed position



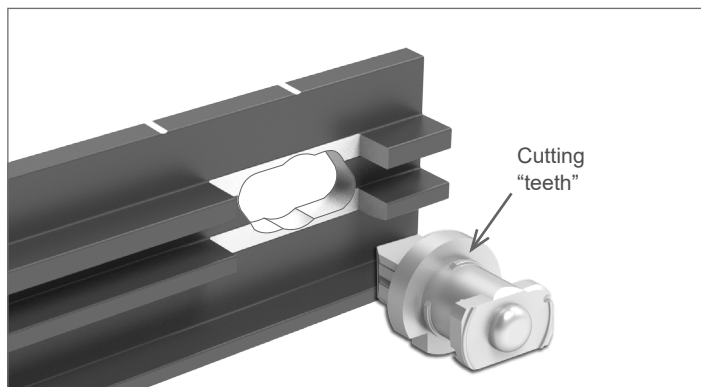
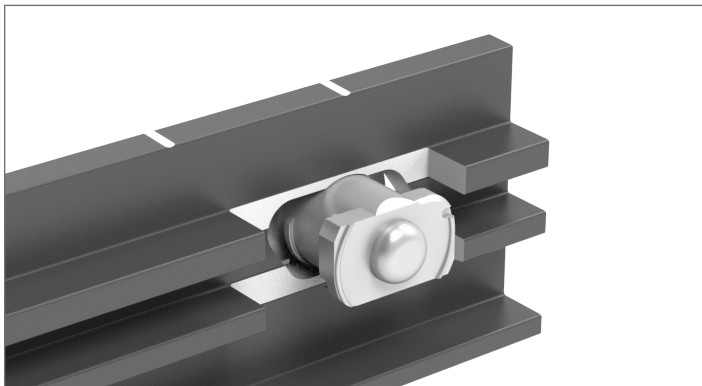
Side View



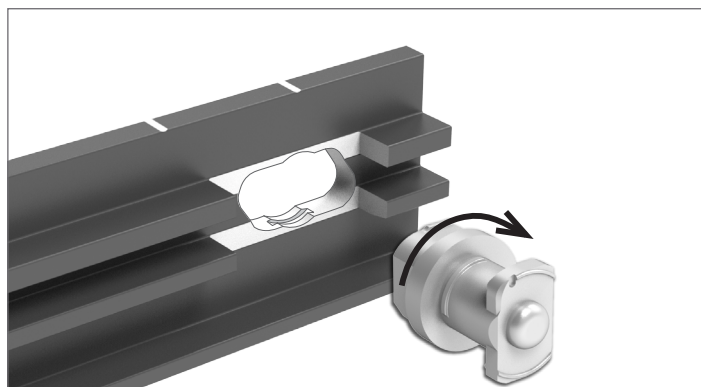
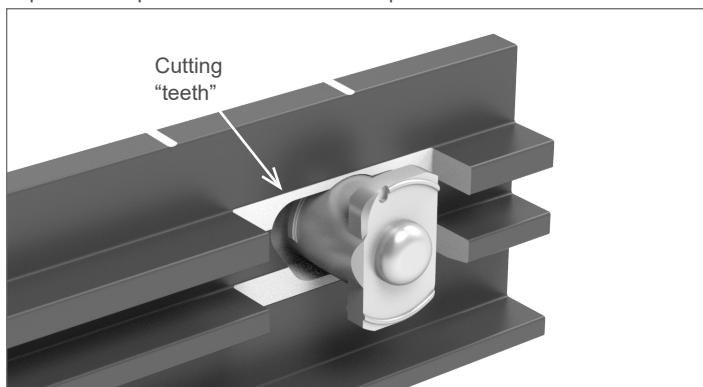
ZEP TO INTERLOCK BONDING

The rotating fastener attached to the Interlock plate, called the “Zep” or “Interlock Zep”, has two cutting teeth on the shaft that cut into the Interlock plate when the Zep is tightened during normal installation, resulting in robust and UL certified bonding path. The Interlock may be re-installed up to 15 times.

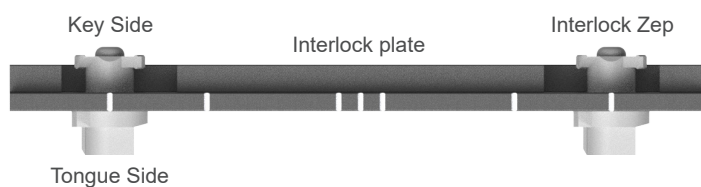
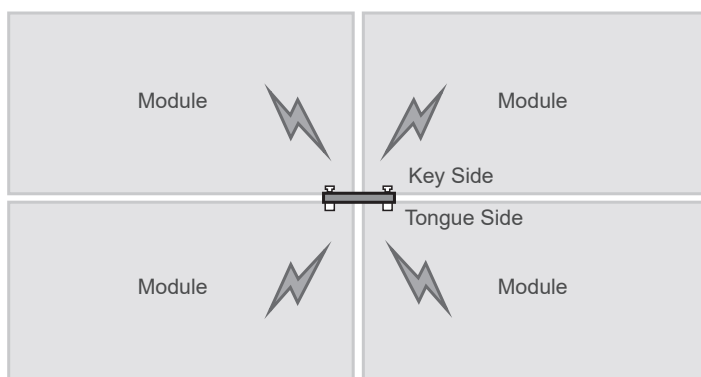
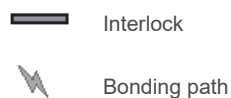
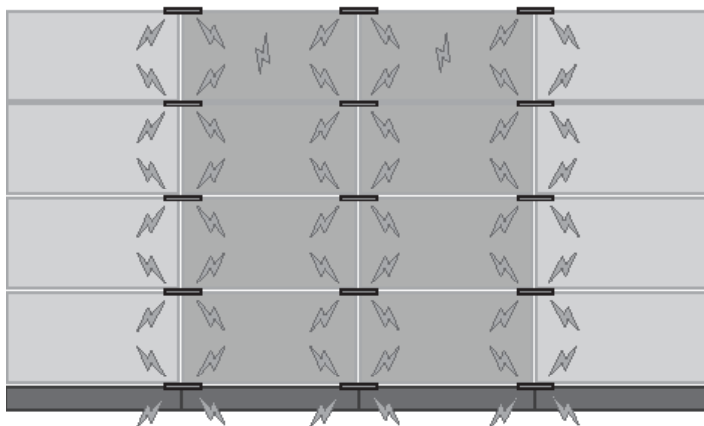
Zep in open position.



Zep in locked position cuts into Interlock plate.



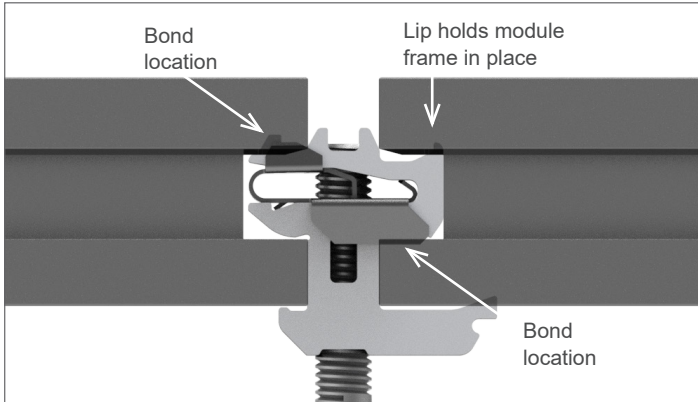
The Interlock bonds modules on all 4 sides and across the Interlock plate to create a hyper-bonded array where every module is structurally and electrically bonded to the surrounding modules.



ROCKIT

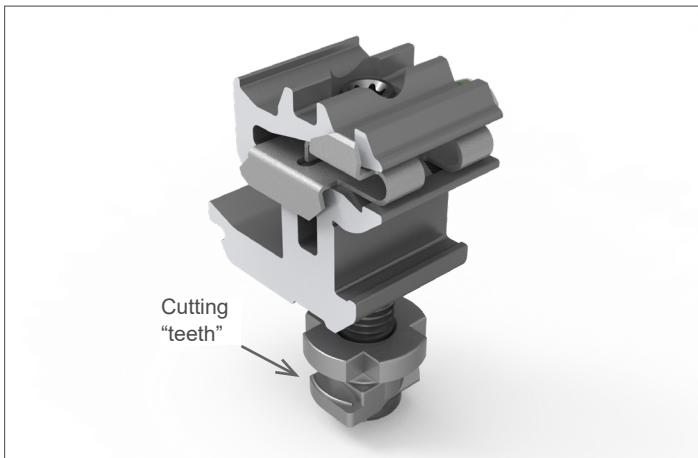
KEY & TONGUE SIDE BONDING

The Rockit has a stainless steel spring clip that bonds to the adjacent module frame on both Key and Tongue sides. A module can be pulled out to the edge of the lip and still be correctly installed, allowing for small variations in module sizes.



CAM FOOT BONDING

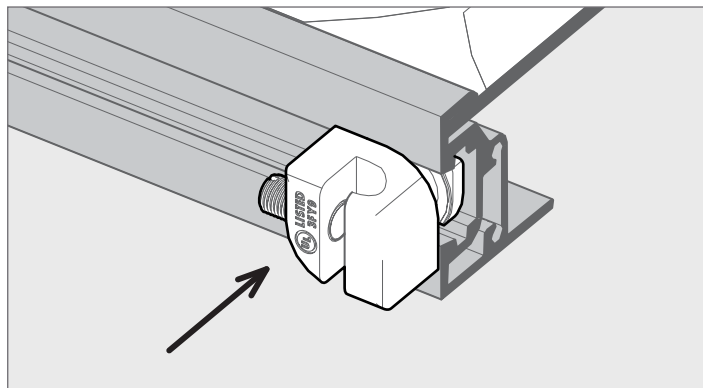
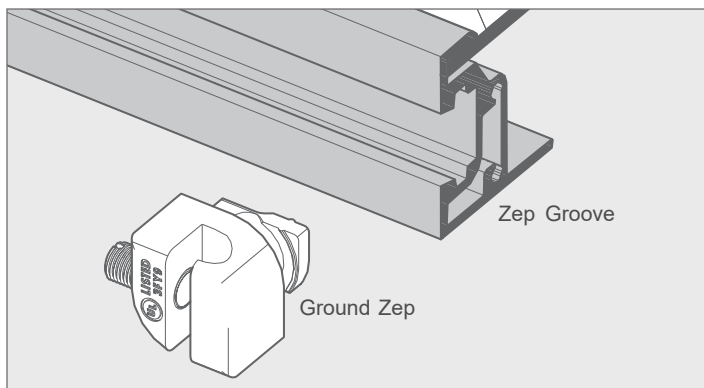
The Cam Foot base has two cutting teeth that cut into the Ramp Rail when rotated.



GROUND ZEP

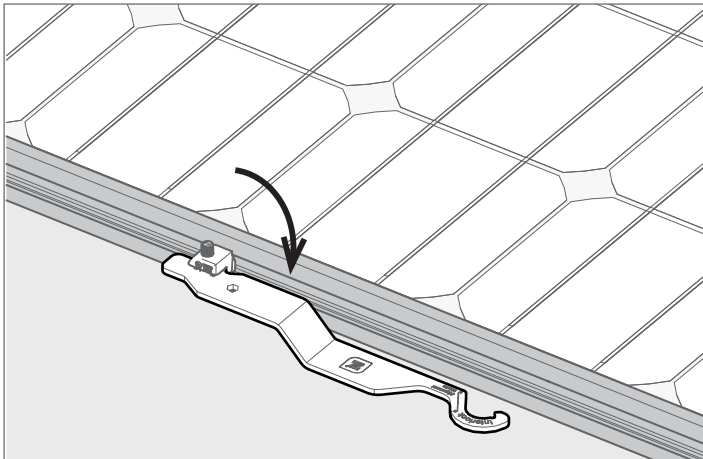
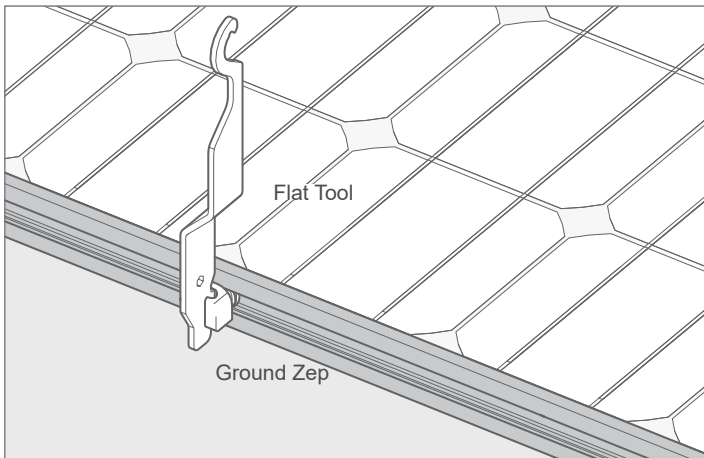
1. INSERT GROUND ZEP

The Ground Zep provides a single point of connection for the Equipment Grounding Conductor (EGC) from the array to a building ground. Insert a Ground Zep into the Zep Groove with the Set Screw pointing left.



2. LOCK GROUND ZEP

Using either a Zep Tool or the Flat Tool (shown), lock the Ground Zep into place with a 90 degree clockwise turn. The Set Screw should be pointing straight up.



3. INSERT GROUND WIRE

Insert solid copper ground wire into ground wire retention slot.

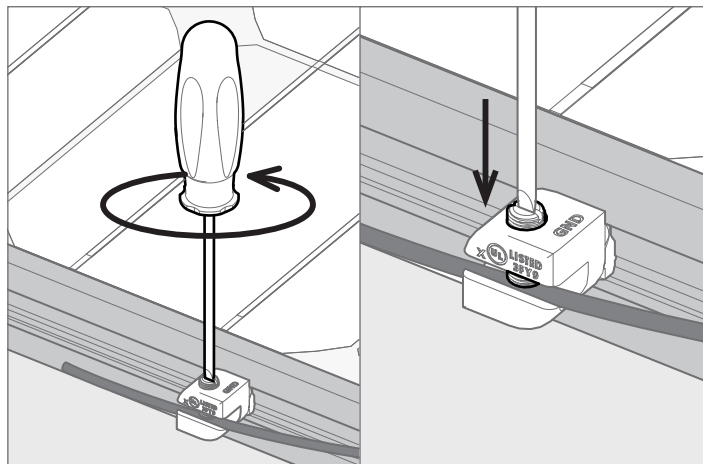
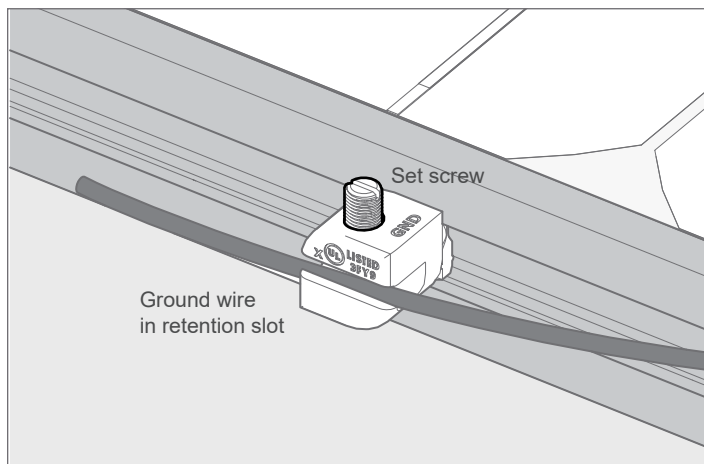
To fully secure the ground wire, torque the set screw as follows:

14-10 AWG: 40 INCH-LBS

8 AWG: 45 INCH-LBS

6 AWG: 50 INCH-LBS

4 AWG: 55 INCH-LBS



APPENDIX: THERMAL EXPANSION

There are two methods to address thermal expansion and contraction within Tesla Zep Compatible™ arrays: Thermal Expansion Joints and physical gaps or breaks between sub-arrays.

Thermal Expansion Joints consist of Interlocks that are installed in a manner that allows modules to slide back and forth as they expand and contract in response to daily temperature swings on the roof. This allows the modules some added flexibility to expand in the direction that the Interlocks are running. In the other direction (North-South in the case of ZS Ramp), a physical gap is required to allow for thermal expansion of the modules. Generally, a gap of at least 12" between sub-arrays is recommended, both for thermal expansion and to allow access by work crews for module servicing.

WHEN ARE THERMAL EXPANSION JOINTS NEEDED?

Thermal expansion must be addressed under the following conditions:

- Array sizes larger than 10 meters or approximately 33 feet in either direction.
- After two consecutive Thermal Expansion Joints, a physical gap is required.

NOTE: For example, a typical 60-cell polycrystalline module would require thermal expansion every 6 module lengths or 10 module widths, or approximately every 60 modules assuming a square array.

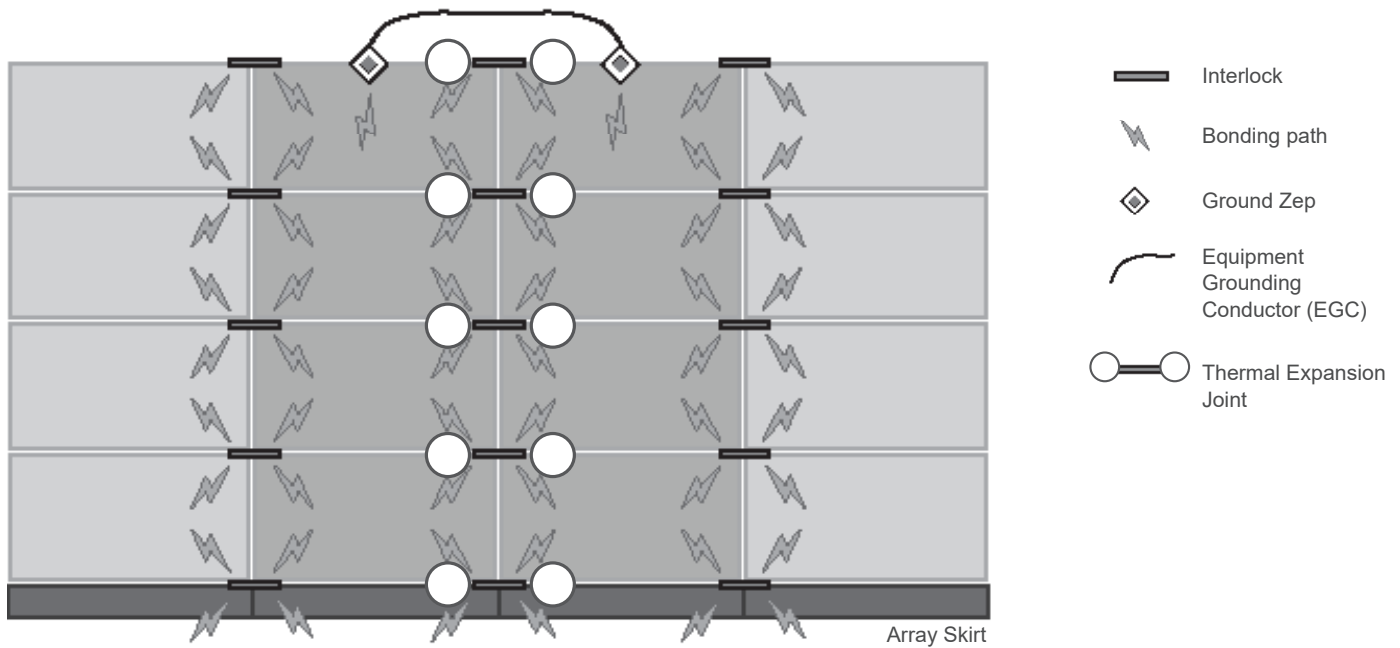
INSTALLING THERMAL EXPANSION JOINTS

Thermal Expansion Joints use the Interlock component, which is used to connect and bond two modules together. To create a Thermal Expansion Joint between two modules, rotate the Interlock Zep on one side to Position 3 (locked position) using the Zep Tool. Rotate the Interlock Zep on the other side to Position 2. Position 2 provides a structural connection, but does not establish an electrical bond. This allows the module on the side of Position 2 to slide back and forth as the modules expand and contract in changing temperatures.

NOTE: Thermal Expansion Joints require that a Ground Zep be installed on both sides of the break.

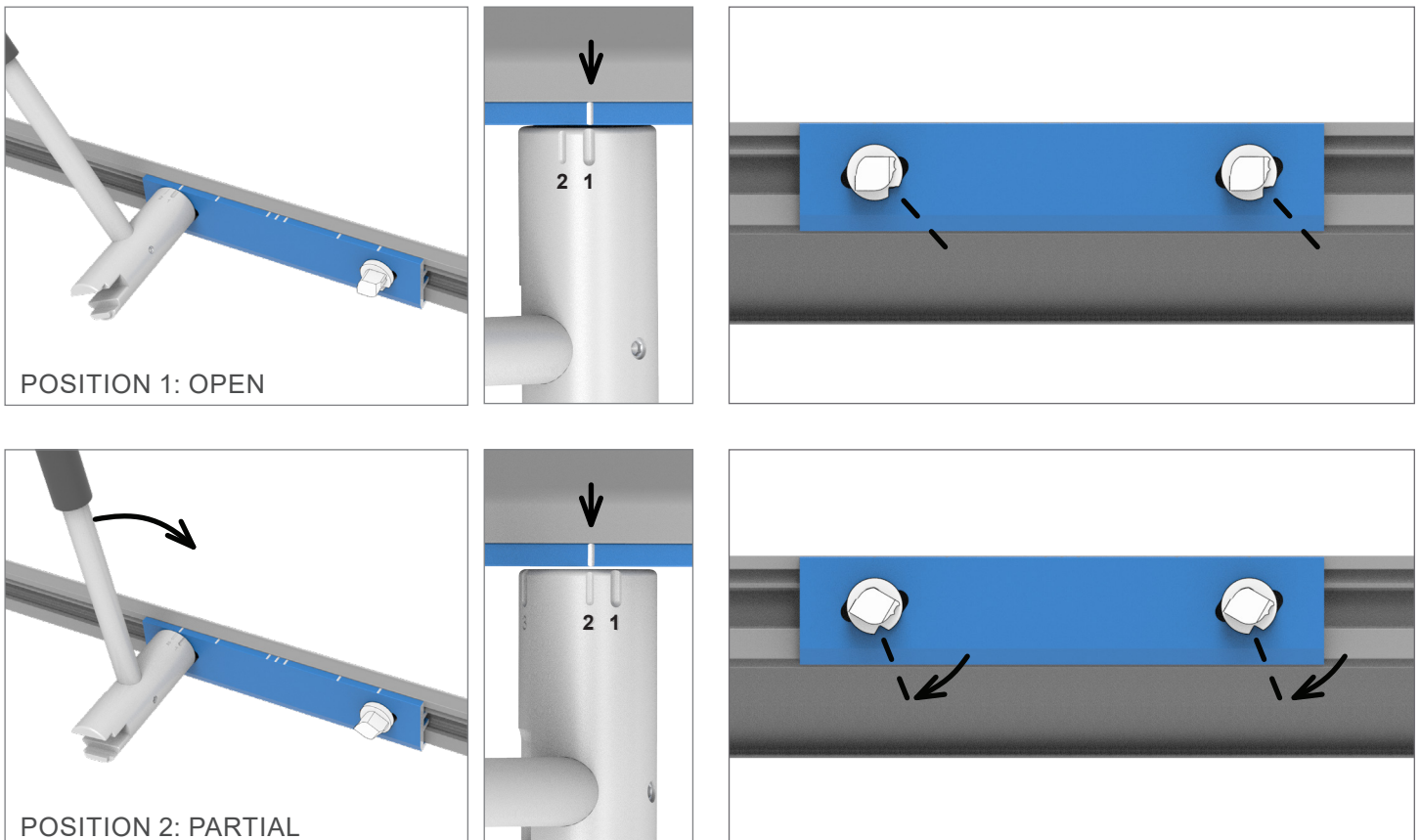
THERMAL EXPANSION JOINTS AND MODULE COLUMNS

When there is a continuous column of Interlocks all serving as a thermal expansion joint, all Interlocks must be tightened consistently going up the column. In most cases, one side is turned to **Position 3**, and the other side to **Position 2**, the exception being a staggered array. For example, a North-South drop-in with thermal expansions that run East-West could be installed as follows:



Thermal Expansion Joint: Interlock Tightening Positions, North-South Drop-In

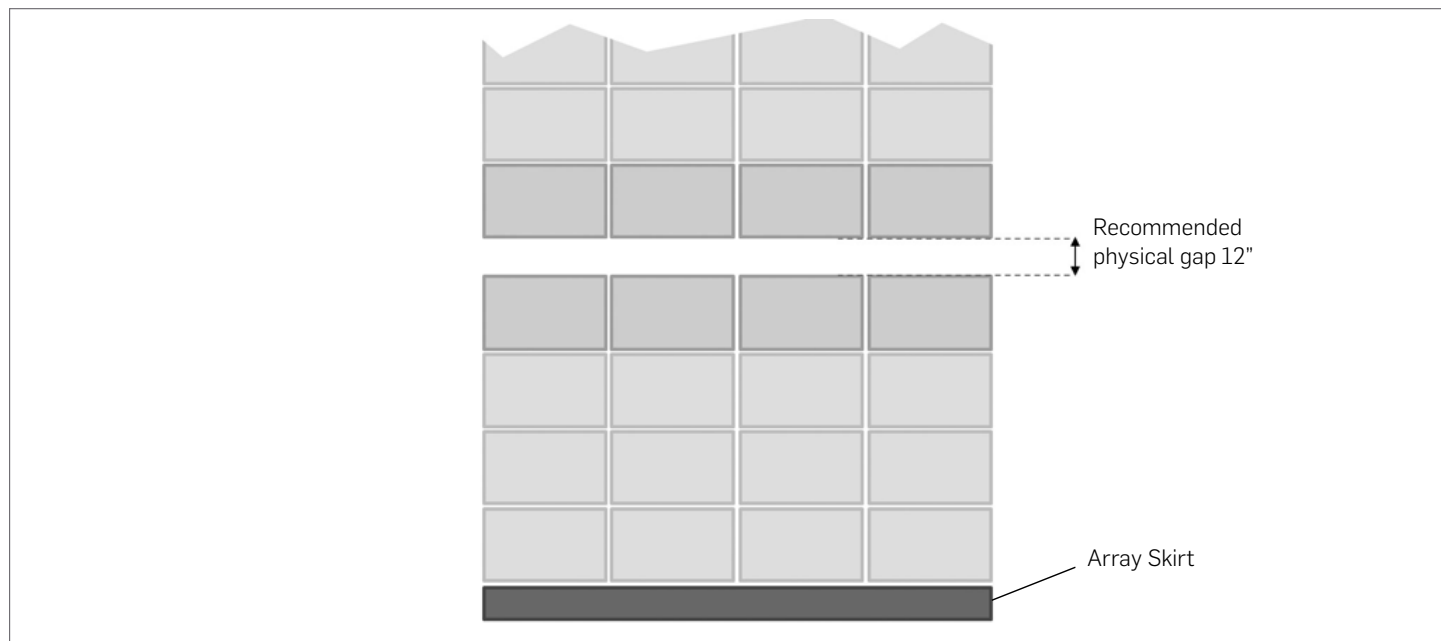
Note that the Interlock **Position 3** also locks in the Tongue side modules (up-roof side) as well.



PHYSICAL GAPS BETWEEN SUB-ARRAYS

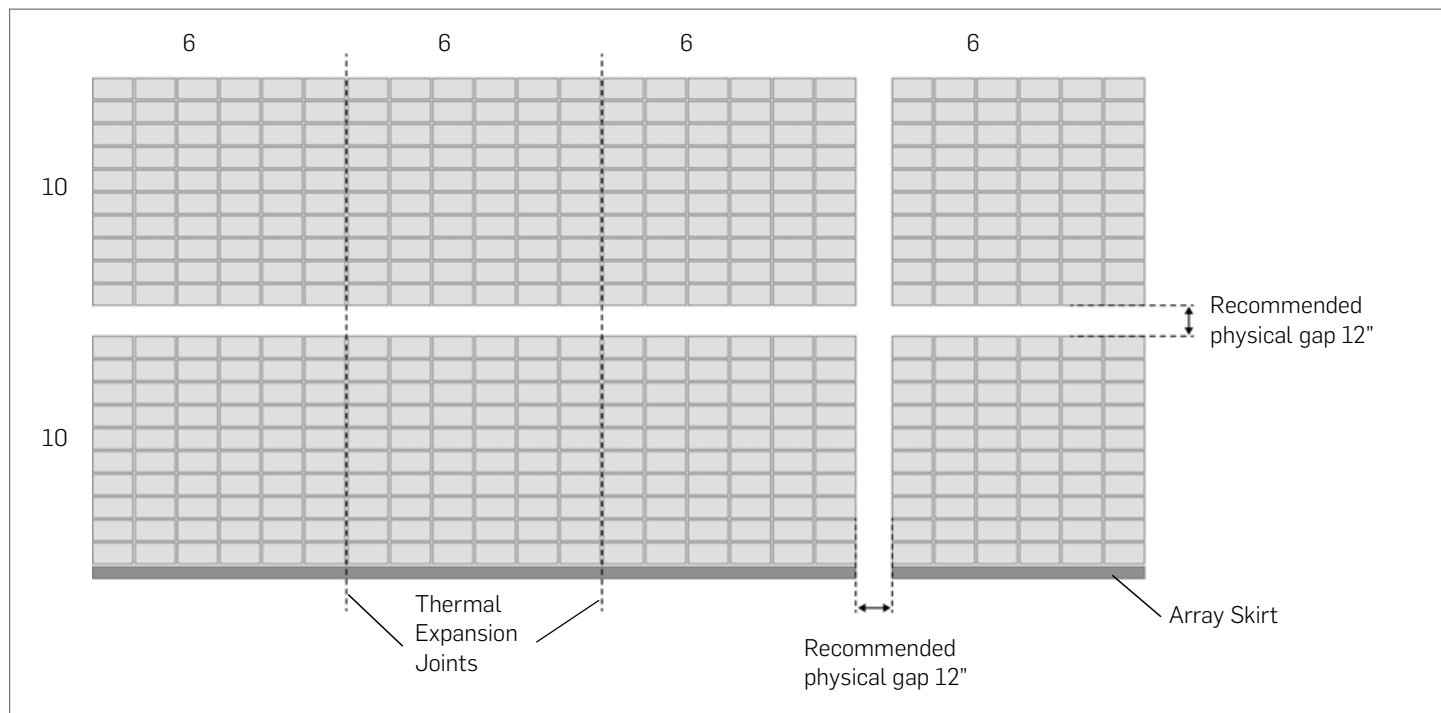
Thermal Expansion Joints only work along the axis of the Interlock. Thermal expansions running along the other axis (parallel to the module drop-in direction) require a physical break between the sub-arrays. For example, a vertical North-South drop-in may require physical breaks between rows.

At a minimum, the gap should be at least 4 inches or 100 mm. However, a gap of 12 inches or 300 mm is recommended for ease of servicing.



North-South Drop-In, North-South Thermal Expansion Gap

Along the axis of the Interlock, large arrays also need a physical gap after two Thermal Expansion Joints. For example, a North-South drop-in, Landscape orientation, might require a physical gap approximately every 30 meters or 100 feet. This would be approximately every 18 module lengths, depending on the module.



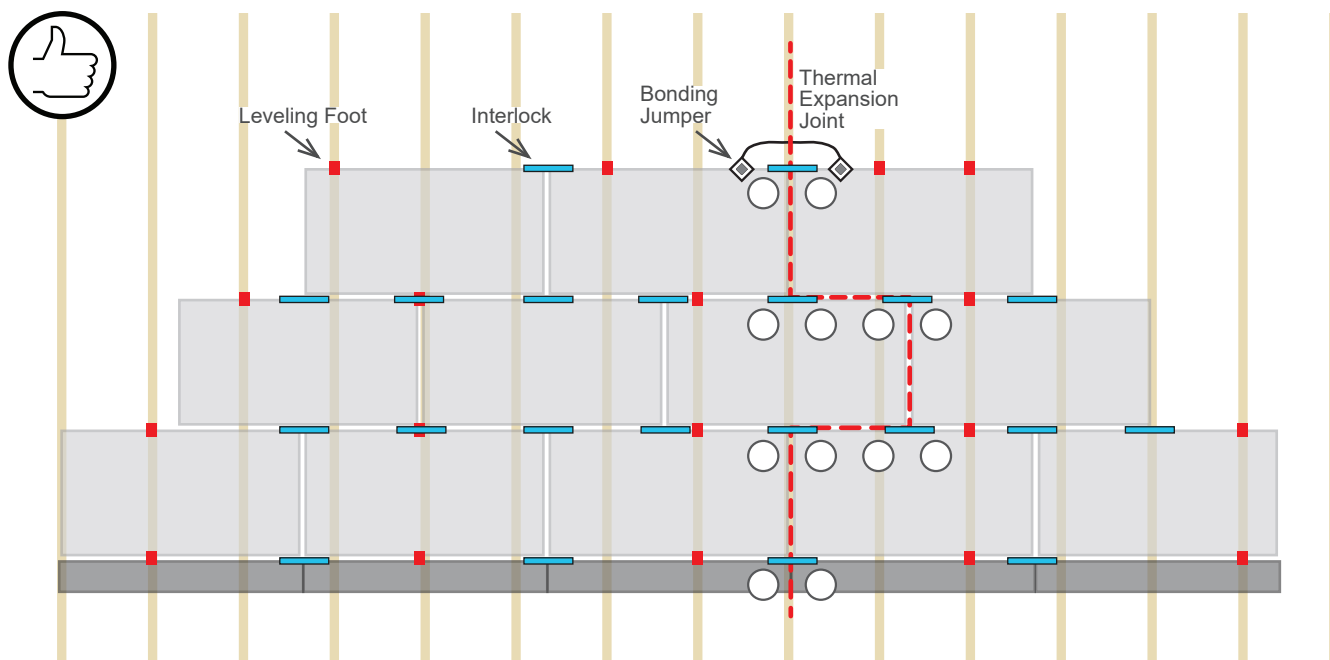
North-South Drop-In, North-South Thermal Expansion East-West

THERMAL EXPANSION JOINTS IN STAGGERED ARRAYS

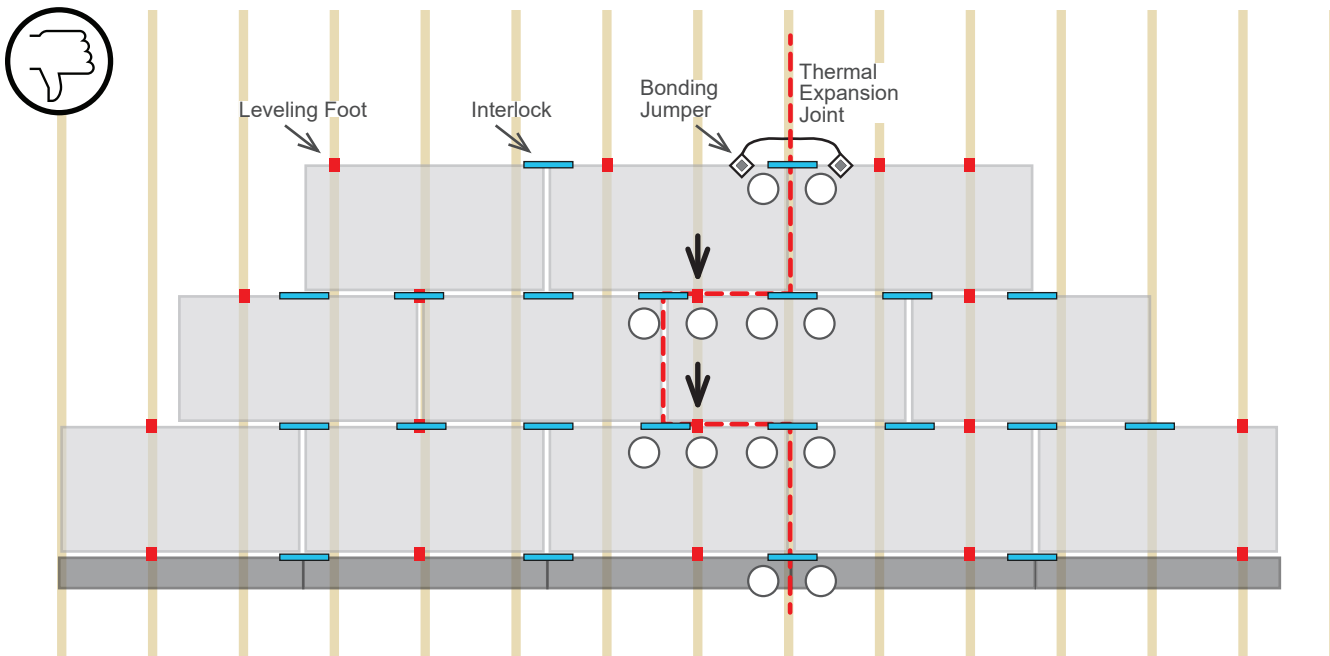
When module rows are offset from one another, creating a Thermal Expansion Joint is more complex, requiring additional Interlocks and a continuous path between them **with no intervening Feet**.

Thermal Expansion Joints on staggered arrays require Interlocks at each juncture where the array is intended to split apart. Each Interlock Zep is turned to Position 2 on one side (allows thermal expansion) and Position 3 (fully locked in place) on the other such that there is an unbroken line between the Zeps that are at Position 2. The installer must not place any Leveling Feet or Cam Feet between these points.

Thermal Expansion Joint for Staggered Arrays: correct layout with no intervening feet between Interlocks.



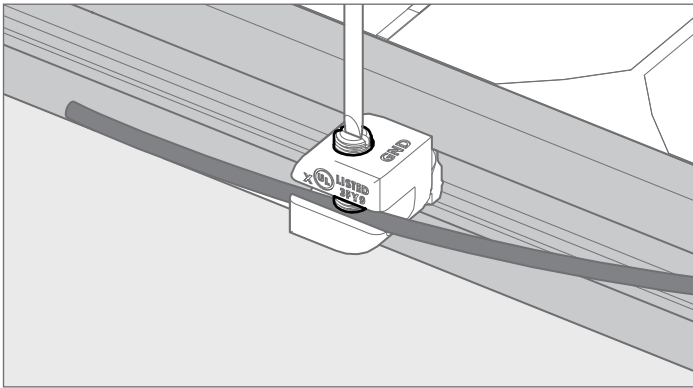
Thermal Expansion Joint for Staggered Arrays: incorrect layout with intervening feet between Interlocks.



APPENDIX: MODULE SERVICE-

1. MAINTAIN GROUND PATH

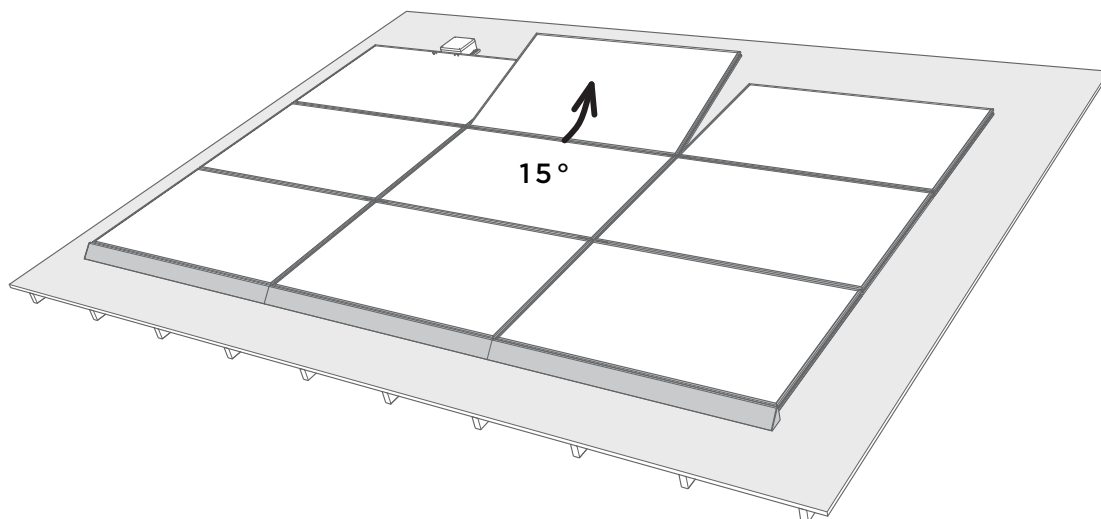
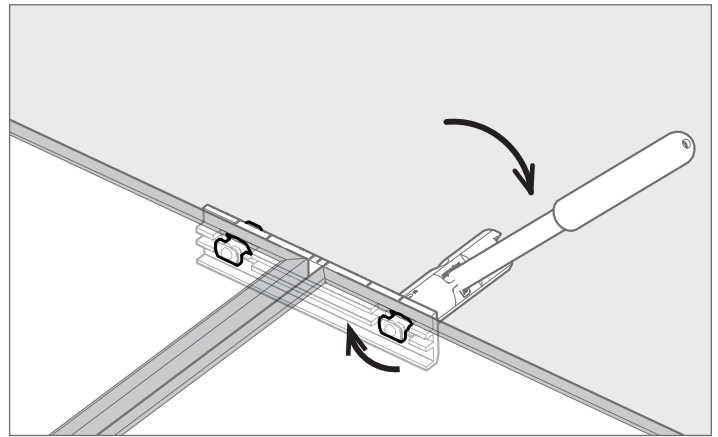
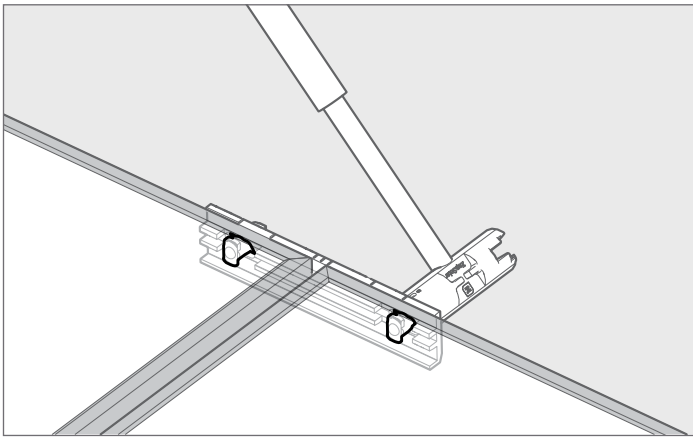
In the event a module must be removed for servicing, use additional Ground Zeps as needed to ensure the ground path is maintained.



2. DISCONNECT MODULE WIRES AND JUMPERS

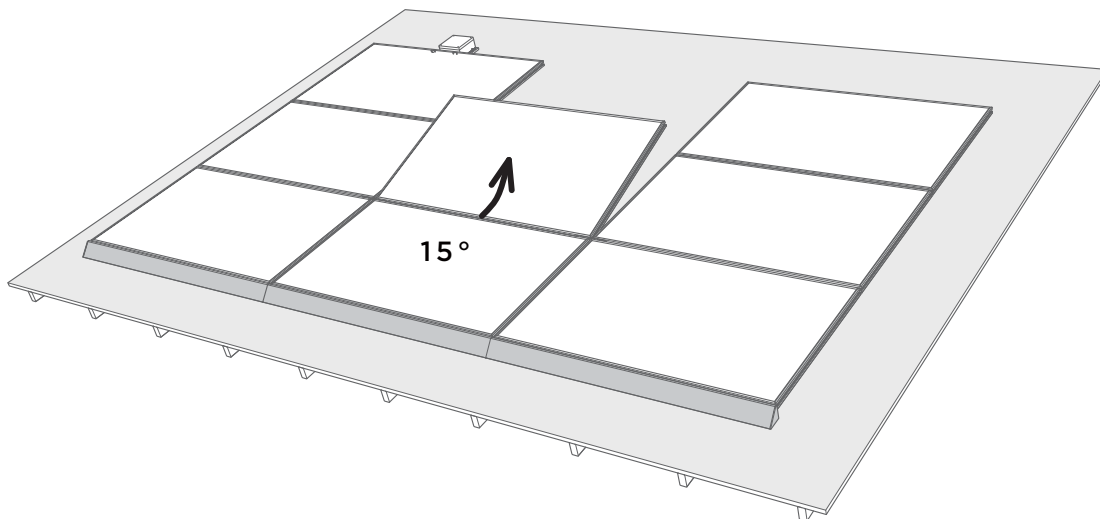
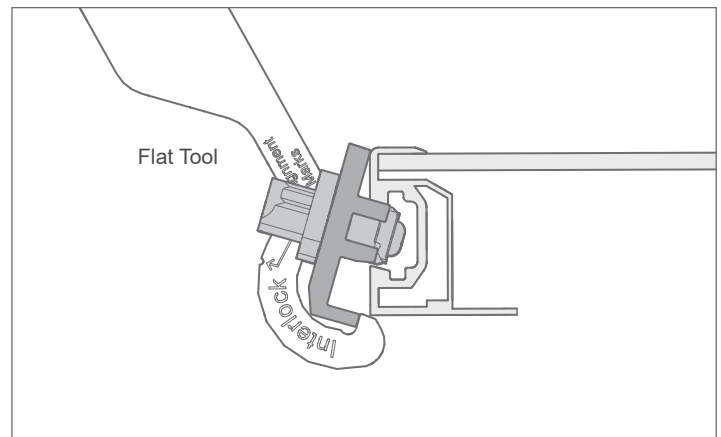
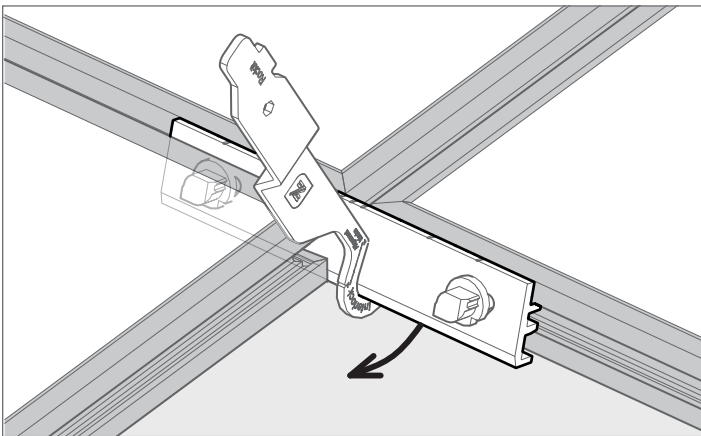
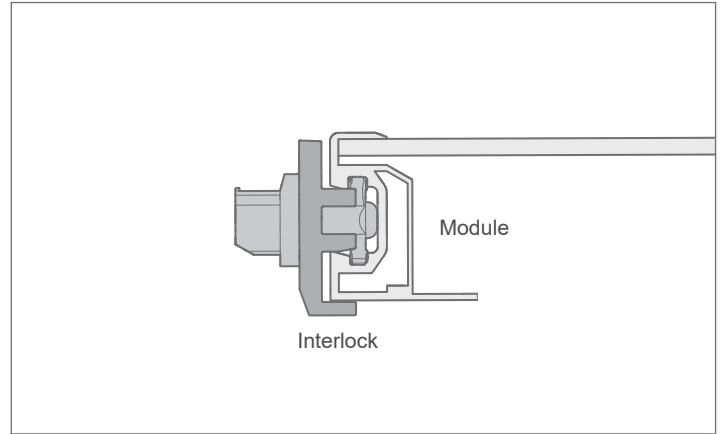
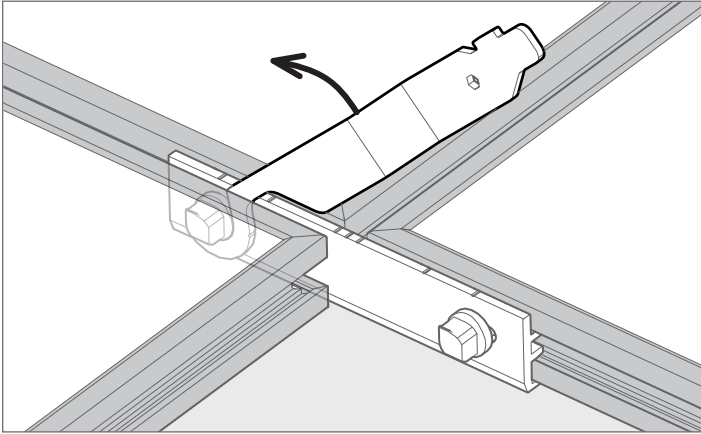
3. RELEASE OUTER MODULES

Remove all Interlocks at the top of the column containing the target module, or module needing replacement. Remove the first module by lifting it up at a 15 degree angle and pulling it off the front Cam Feet and Interlocks.



4. RELEASE MID-ARRAY MODULES

Use the Flat Tool to unlock the mid-array Interlocks and release the modules.



5. RE-ASSEMBLE ARRAY

Replace modules, Cam Feet, and Interlocks until the array is complete. Use the Flat Tool to fasten mid-array Interlocks.