GFT GROUND FIXED TILT

INSTALLATION GUIDE



UNIRAC Code-Compliant Installation Manual

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PUB2026OCT13

GFT GROUND FIXED TILT

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TABLE OF CONTENTS

SYSTEM COMPONENTS 1-3
STANDARD END & MID CLAMP ASSEMBLIES 4
RAIL CLIP & BEAM SPLICE 5
TOP CHORD & DIAGONAL PILE CONNECTIONS 6
INSTALLATION STEPS 7-28
ELECTRICAL CONSIDERATIONS 29-30
MECHANICAL LOAD TEST 31
COMPATIBLE MODULES 32-38
APPENDIX A: UNIVERSAL AF CLAMPS INSTALLATION 39-40
APPENDIX B: PRO SERIES CLAMPS INSTALLATION 41-42
APPENDIX C: GROUND LUG INSTALLATION 43

Safety Note: Cold formed steel components may have sharp edges after fabrication. Appropriate PPE should be worn to avoid injury.

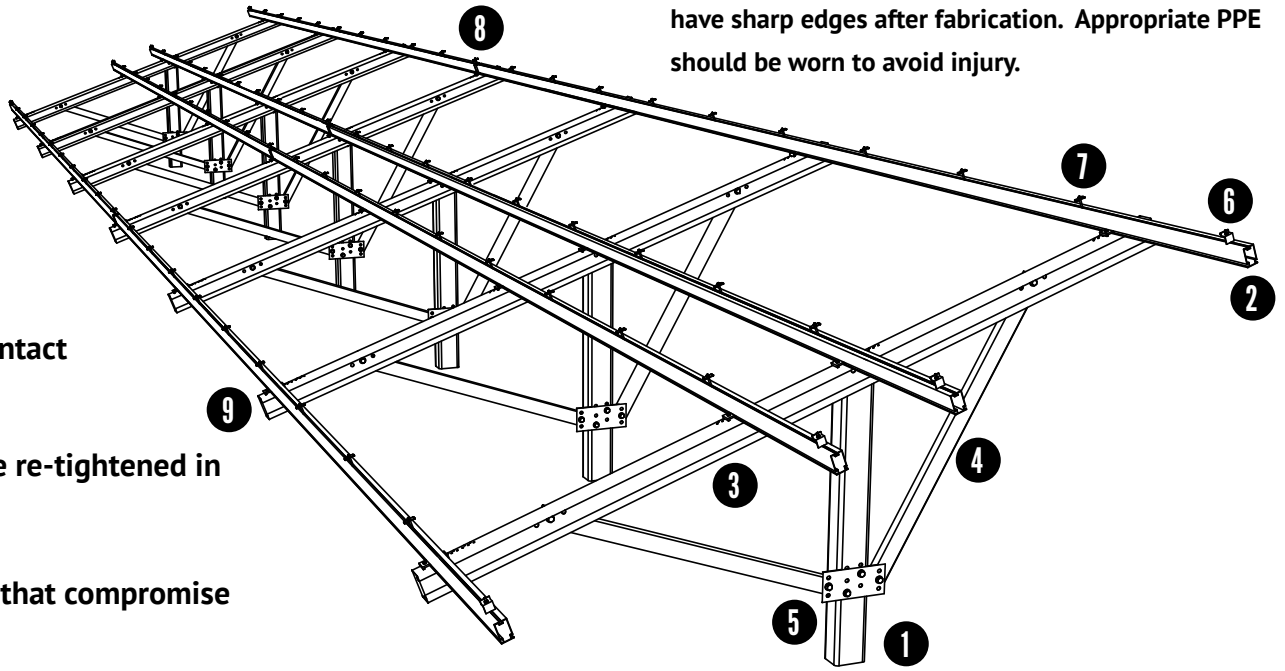
Safety Notes:

Cold formed steel components may have sharp edges after fabrication. Appropriate PPE should be worn to avoid injury.

Load ratings are project specific - please contact Unirac or refer to U-Builder.

Any loose components or fasteners shall be re-tightened in accordance with these instructions.

Any components showing signs of damage that compromise safety shall be replaced immediately.

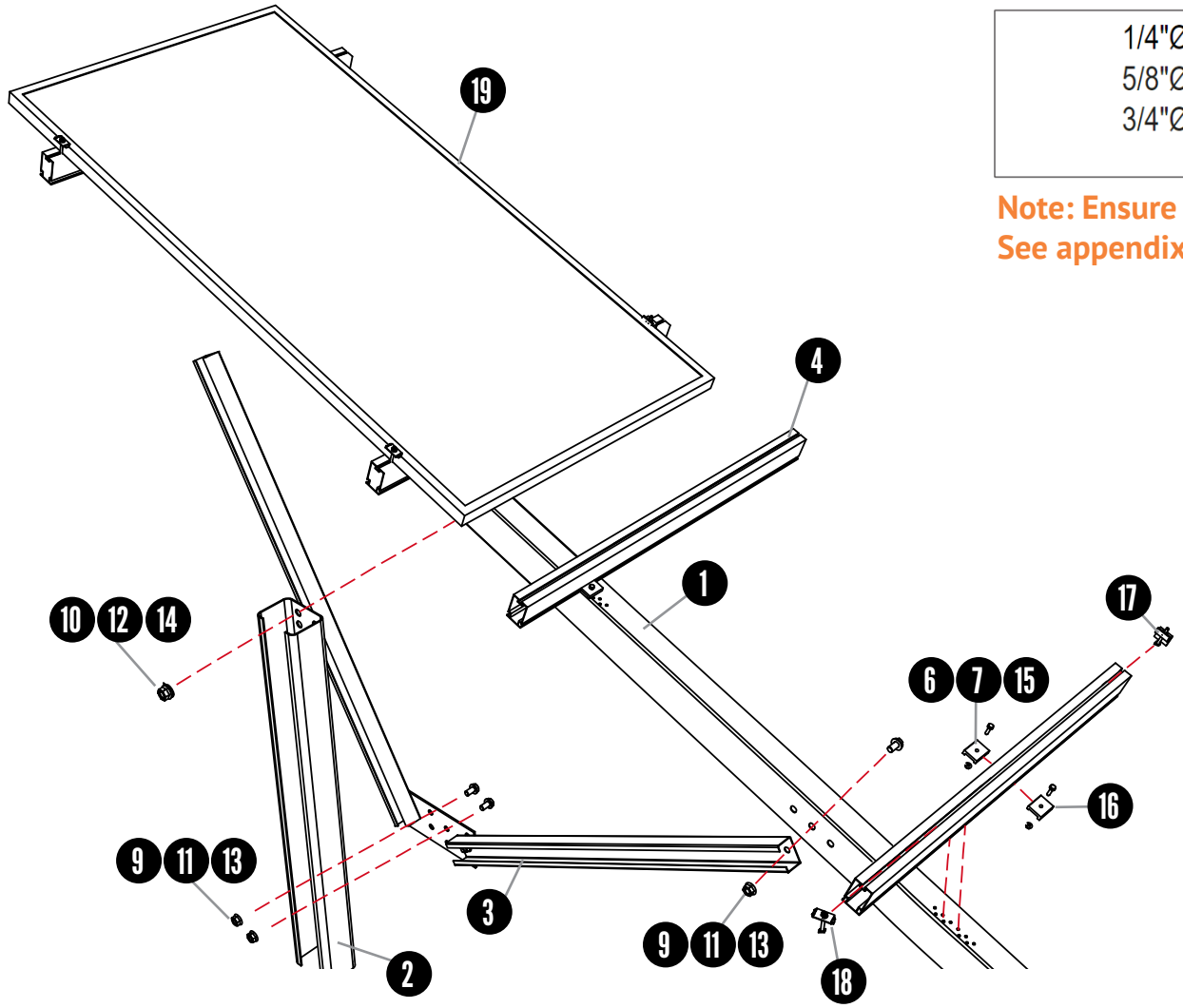


ITEM	COMPONENT	MATERIAL
1	Roll- Formed Steel Pile	4" or 4.5 " x 6" C Shape (Length Varies by Project)
2	Aluminum East-West Beam	Aluminum Beam with Continuous Slots for Adjustability
3	Roll-Formed Steel Top Chord	C Shape with Custom Hole Pattern for Adjustability
4	Roll-Formed Steel Diagonal Brace	C Shape
5	Steel Diagonal Brace Plate	Steel Plate with Custom Hole Pattern for Adjustability
6	End Clamp	End Clamp Assembly with T-Bolt
7	Mid Clamp	Mid Clamp Assembly with T-Bolt
8	Nested Splice Member	Internal Aluminum Splice Retained with Self-Tapping Screws
9	East-West Beam Clamp	Aluminum Extruded Clamp with Stainless Steel Hardware

TORQUE REQUIREMENTS FOR THE GFT PRODUCT:

1/4"Ø HARDWARE =	9 - 11 FT-LBS
5/8"Ø HARDWARE =	54 - 66 FT-LBS
3/4"Ø HARDWARE =	99 - 121 FT-LBS

Note: Ensure Torque wrenches have been calibrated.
See appendix for different clamp configurations



ITEM	COMPONENT
1	4.1" Top Chord Channel
2	6" x 4" or 4.5" C-Shape Pile
3	Diagonal Brace Assembly
4	3.25" x 2" East-West Aluminum Beam
5	Rail Splice - See page 6
6	Flat Washer 1/4"
7	Hex Flange Nut 1/4-20 Serrated
8	Rail splice connection - See page 6
9	Flat Washer 5/8"
10	Flat Washer 3/4"
11	Hex Bolt 5/8-11" x 1-1/2"
12	Hex Bolt 3/4-10" x 1-1/2"
13	Hex Flange Nut 5/8-11 Serrated
14	Hex Flange Nut 3/4-10 Serrated
15	Hex Bolt 1/4-20 x 1"
16	East-West Rail Clip
17	Standard End Clamp Assembly
18	Standard Mid Clamp Assembly
19	PV Module (By Others)

GFT 4 RAIL COMPONENTS

S.No.	Part Number	Description
1	404001	GFT C-PILE, 12.5'
2	404002	GFT C-PILE, 15.0'
3	404004	GFT C-PILE, 10.5'
4	404037	GFT TOP CHORD CHANNEL 20/30 LF
5	404031	GFT DIAG BRACE ASSEMBLY 20D SR
6	404032	GFT DIAG BRACE ASSEMBLY 30D SR
7	404013	GFT ASSEMBLY HARDWARE 4-RAIL KIT
8	411166M	GFT RAIL 166" MILL
9	411246M	GFT RAIL 246" MILL
10	404014 & 404014-US	KIT, GFT RAIL SPLICE W/ HDWR
11	404015	GFT WIRE MANAGEMENT CLIP
12	404020	GFT RAIL SUPPLEMENTAL HDWR 4-RAIL
13	GFT-CAP	GFT RAIL END CAP, UV-BLK

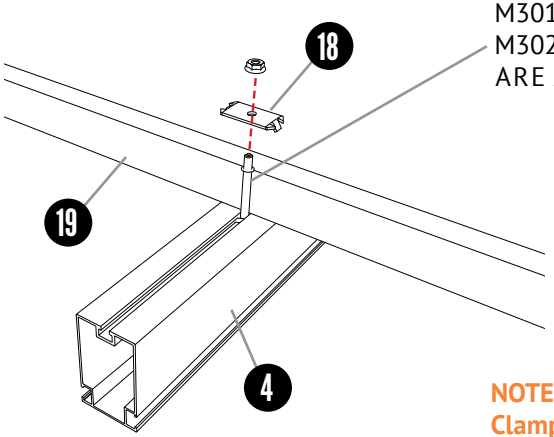
SYMBOL	DESCRIPTION
AL	ALUMINUM
CLR	CLEAR ANODIZED
DRK	DARK BRONZE ANODIZED
SS	STAINLESS STEEL
DRK SS	BLACK OXIDE COATED STAINLESS STEEL

LETTER	SUPPORTED MODULE THICKNESS
B	30MM -32MM
C	33MM -36MM
D	38MM -40MM
K	39MM -41MM
F	45MM -47MM
E	50MM -51MM

MID CLAMPS AND END CLAMPS

S.NO.	PART NUMBER	DESCRIPTION
1	302021C	SM ENDCLAMP B CLR AL
2	302021D	SM ENDCLAMP B DRK AL
3	302022C	SM ENDCLAMP C CLR AL
4	302022D	SM ENDCLAMP C DRK AL
5	302023C	SM ENDCLAMP D CLR AL
6	302023D	SM ENDCLAMP D DRK AL
7	302024C	SM ENDCLAMP E CLR AL
8	302024D	SM ENDCLAMP E DRK AL
9	302025C	SM ENDCLAMP F CLR AL
10	302025D	SM ENDCLAMP F DRK AL
11	302026C	SM ENDCLAMP K CLR AL
12	302026D	SM ENDCLAMP K DRK AL
13	302027C	SM BND MIDCLAMP BC SS
14	302027D	SM BND MIDCLAMP BC DRK SS
15	302028C	SM BND MIDCLAMP EF SS
16	302028D	SM BND MIDCLAMP EF DRK SS
17	302029C	SM BND MIDCLAMP DK SS
18	302029D	SM BND MIDCLAMP DK DRK SS
19	302030D	SM MIDCLAMP PRO DRK
20	302030M	SM MIDCLAMP PRO MILL
21	302035M	SM ENDCLAMP PRO W/CAP
22	302045D	UNIVERSAL AF MID CLAMP DRK
23	302045M	UNIVERSAL AF MID CLAMP MILL
24	302050D	UNIVERSAL AF END CLAMP DRK
25	302050M	UNIVERSAL AF END CLAMP MILL
26	U-LUG	GROUNDING LUG KIT

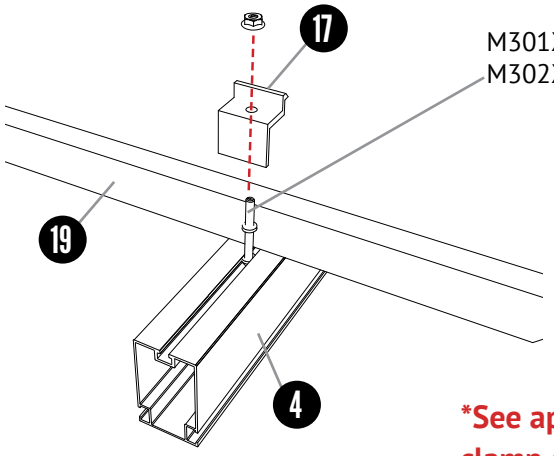
Standard Mid Clamp Assembly with T-Bolt



M301XX: T-BOLT 1/4-20 OR
M302XX: T-BOLT SERR. 1/4-20
ARE ACCEPTABLE

NOTE - Standard Series Mid and End Clamps are single use only

Standard End Clamp Assembly with T-Bolt



M301XX: T-BOLT 1/4-20 OR
M302XX: T-BOLT SERR. 1/4-20

*See appendix for different clamp configurations

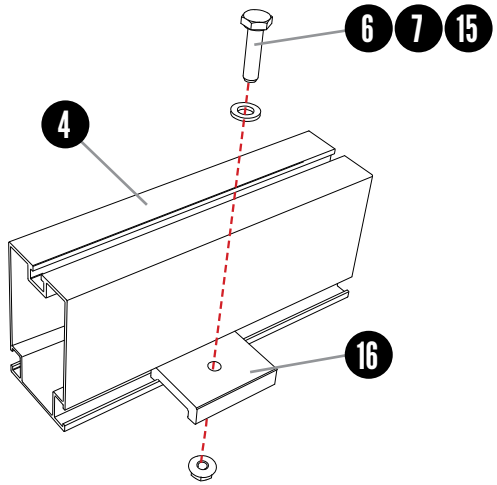
Mid Clamp Assembly With T-Bolt

ITEM	COMPONENT	MATERIAL
4	3.25" x 2" East-West Aluminum Beam	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
18	Mid Clamp	Stainless Steel, 301,302, or 304, 1/4 Hard, Mill Finish
19	PV Module (By Others)	As per Manufacturer
SEE DWG	1/4-20 T-Bolt (Serrated or Non-Serrated)	300 Stainless Steel (301 Preferred)
SEE DWG	1/4-20 Serrated Flange Nut	Stainless Steel ASTM F594

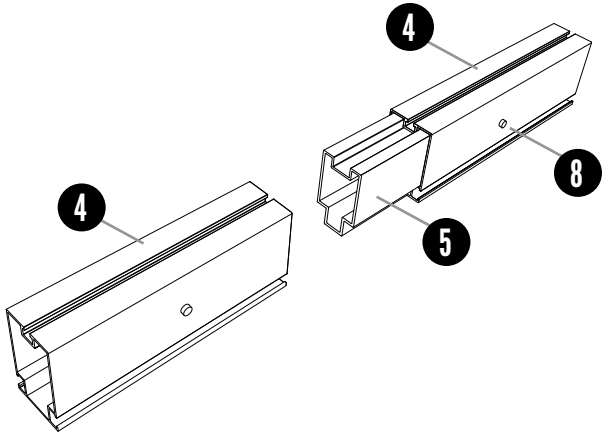
End Clamp Assembly With T-Bolt

ITEM	COMPONENT	MATERIAL
4	3.25" x 2" East-West Aluminum Beam	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
17	End Clamp	Stainless Steel, 301,302, or 304, 1/4 Hard, Mill Finish
19	PV Module (By Others)	As per Manufacturer
SEE DWG	1/4-20 T-Bolt (Serrated or Non-Serrated)	300 Stainless Steel (301 Preferred)
SEE DWG	1/4-20 Serrated Flange Nut	Stainless Steel ASTM F594

East-West Rail Clip



East-West Beam Splice



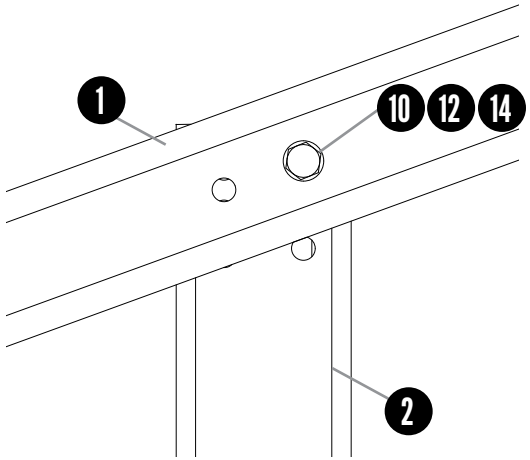
East-West Rail Clip

ITEM	COMPONENT	MATERIAL
4	3.25" x 2" East-West Aluminum Beam	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
6	Flat Washer 1/4"	Stainless Steel ASTM F594
7	Hex Flange Nut 1/4-20 Serrated	302HQ 18/8 Stainless Steel Austenitic 300 Series
15	Hex Bolt 1/4-20 x 1"	302HQ 18/8 Stainless Steel Austenitic 300 Series
16	East-West Rail Clip	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6

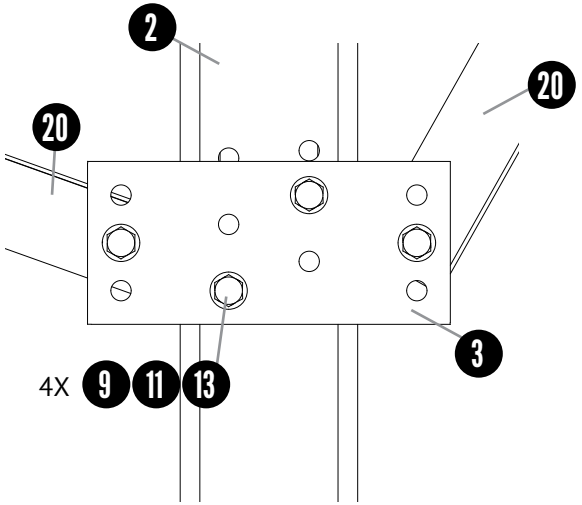
East-West Beam Splice

ITEM	COMPONENT	MATERIAL
4	3.25" x 2" East-West Aluminum Beam	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
5	East-West Beam Splice Insert	Aluminum Alloy 6005A-T61, 6351-T5 or 6061-T6
8	1/4" x 20 Self Drilling Screw (Buildex)	ASTM A449/ SAE J429 (Similar Properties Confirmed by testing)

Top Chord to Pile Connection



Diagonal Brace Plate to Pile Connection

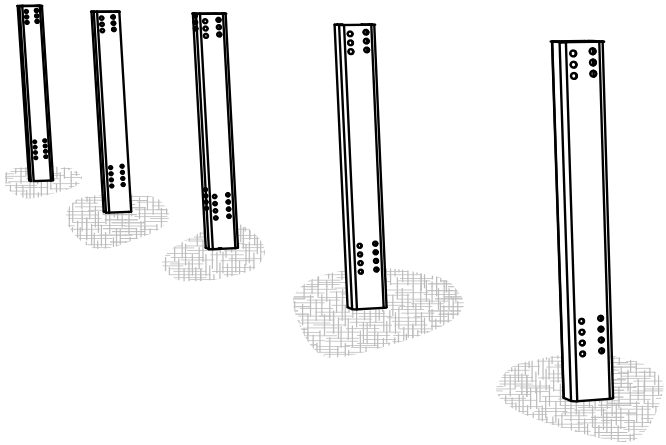


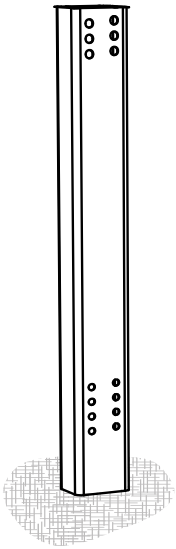
Top Chord to Pile Connection

ITEM	COMPONENT	MATERIAL
1	4.1" Top Chord Channel	Cold Rolled ASTM A653 HSLAS
2	6" x 4 or 4.5" C-Shape Pile	Cold Rolled ASTM A653 HSLAS
10	Flat Washer 3/4"	SAE Type A Narrow
12	Hex Bolt 3/4-10 x 1-1/2"	SAE J429
14	Hex Flange Nut 3/4-10 Serrated	SAE J429

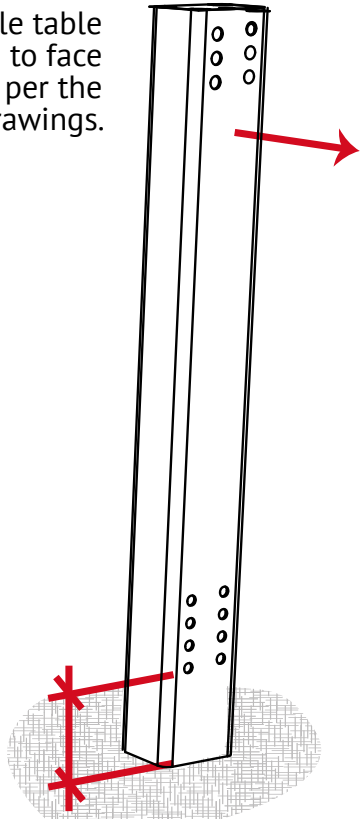
Diagonal Brace Plate to Pile Connection

ITEM	COMPONENT	MATERIAL
2	6" x 4 or 4.5" C Shape Pile	Cold Rolled ASTM A653 HSLAS
3	Diagonal Brace Plate	ASTM A36 or ASTM A653
9	Flat Washer 5/8"	SAE Type A Narrow
11	Hex Bolt 5/8-11 x1-1/2"	SAE J429
13	Hex Flange Nut 5/8-11 Serrated	SAE J429
20	Diagonal Brace	Cold Rolled ASTM A653 HSLAS

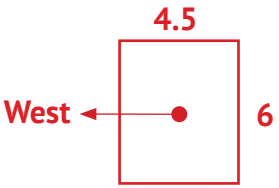




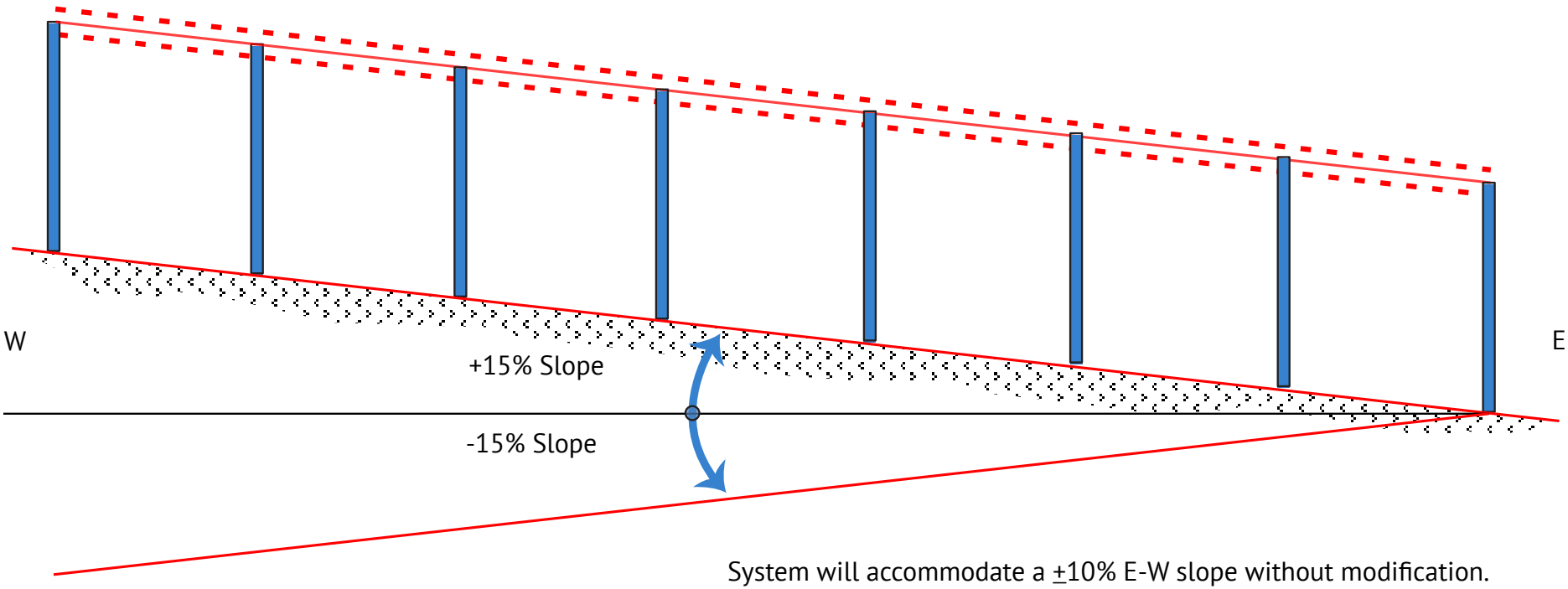
All piles within single table must be oriented to face the same direction per the construction drawings.



Note:
C-Piles must be installed with C open to the West.



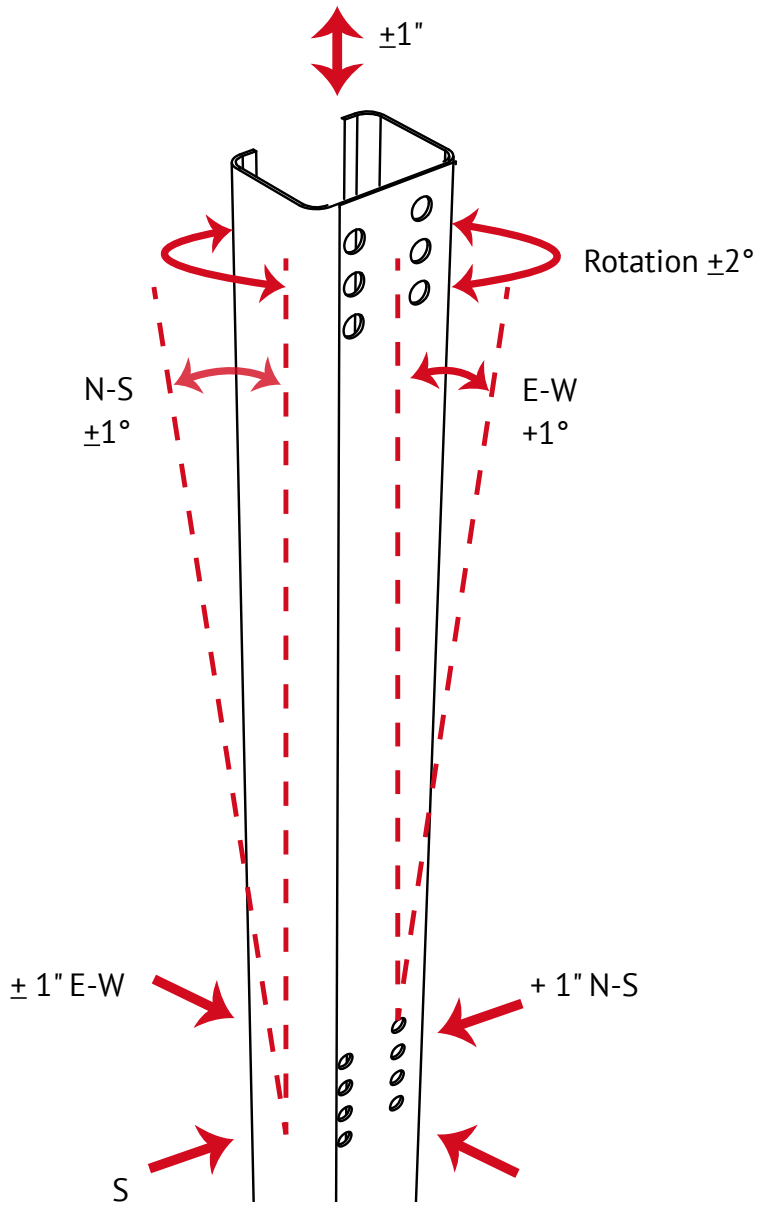
Hole height above grade per construction drawings.



System will accommodate a ±10% E-W slope without modification.

- Plumb tolerances apply regardless of slope.
- Pile position tolerances apply relative to nominal finish grade line.

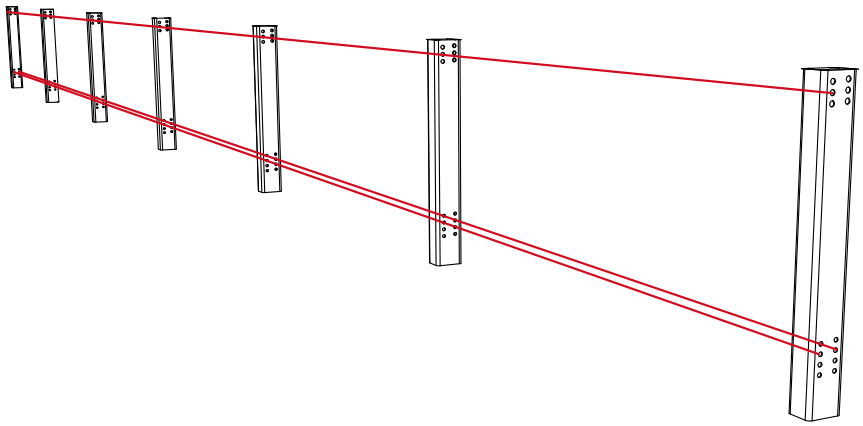
Note:
The GFT system has been installed at an E-W slope of 15%. This is achievable, but requires additional effort to ensure that holes align for bolted connection.

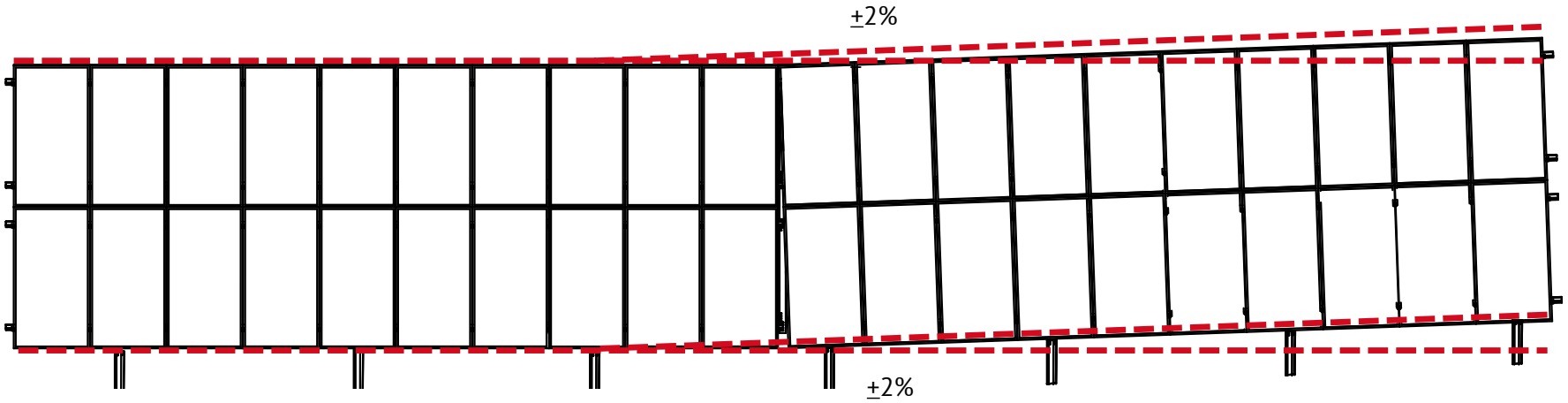

±1"
Rotation ±2°
N-S
±1°
E-W
+1°
± 1" E-W
+ 1" N-S
S

1. Align target hole locations in all piles (within tables and table to table) using laser or string line.

2. Determine if adjustments are needed up or down (hole patterns allow for + 1-1/2" adjustments in 3/4" increments per instruction on following pages).

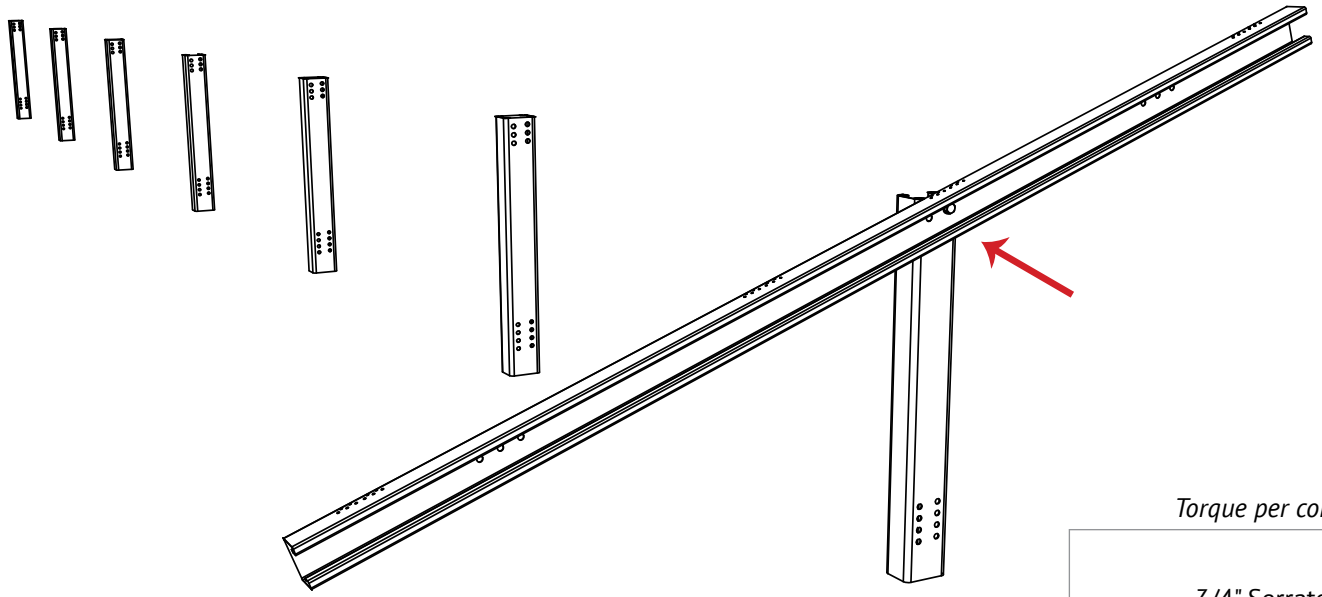
3. Mark holes to be used for top chord and diagonal brace plate attachments prior to installing.



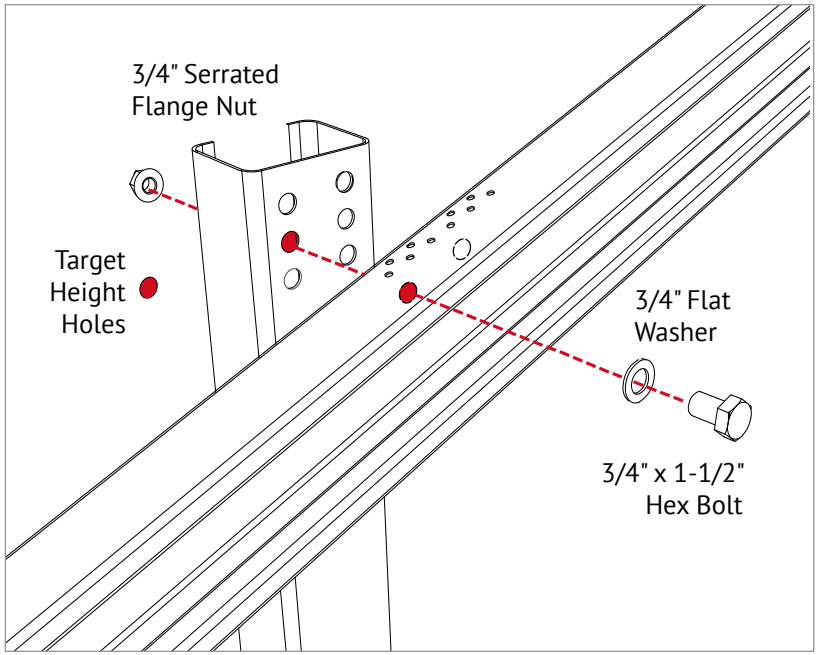


The system is capable of being aligned to the target string or laser line using the adjustment holes when piles are placed within allowable tolerances. Each table will however accommodate a 2% deviation from the target line as shown without impact to structural integrity.

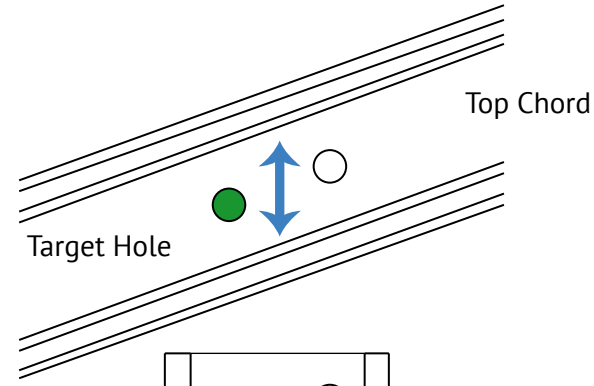
ATTACH TOP CHORD TO PILE

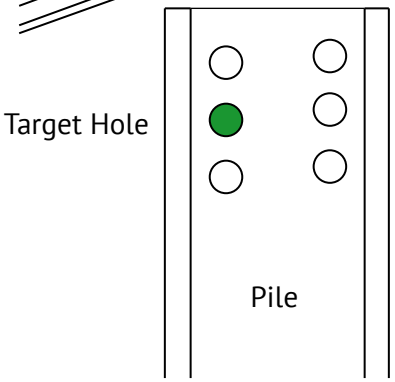


Install hardware snug tight.
Torque per construction drawings after final adjustments.



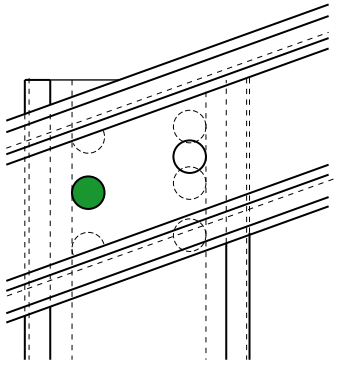
Target Height





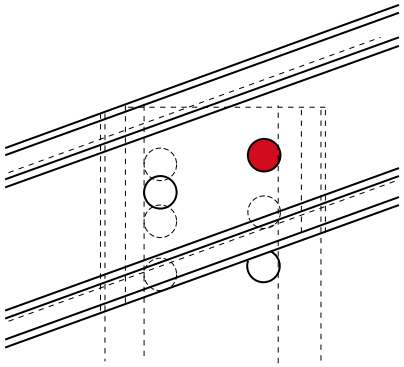
Move top chord up or down (not horizontally) as needed to adjust height in 3/4" increments.

Use single 3/4" bolt (nut and washer) at one of the locations shown.

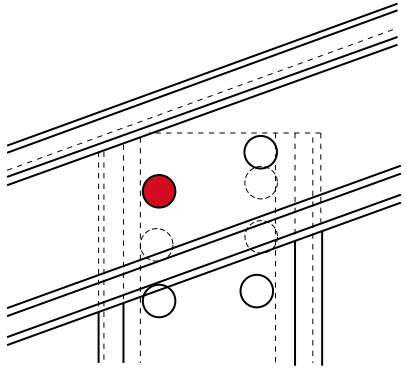


Target Height

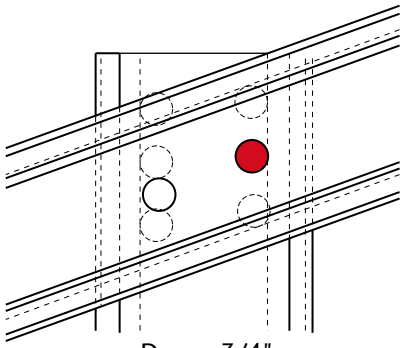
Adjustment Locations (Single 3/4" Bolt)



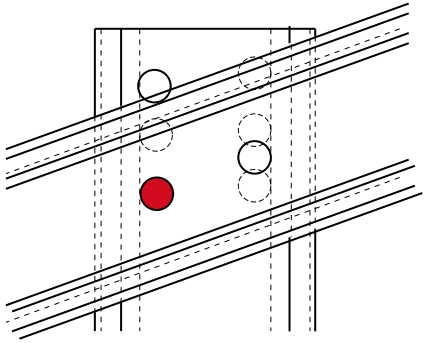
Up 3/4"



Up 1-1/2"

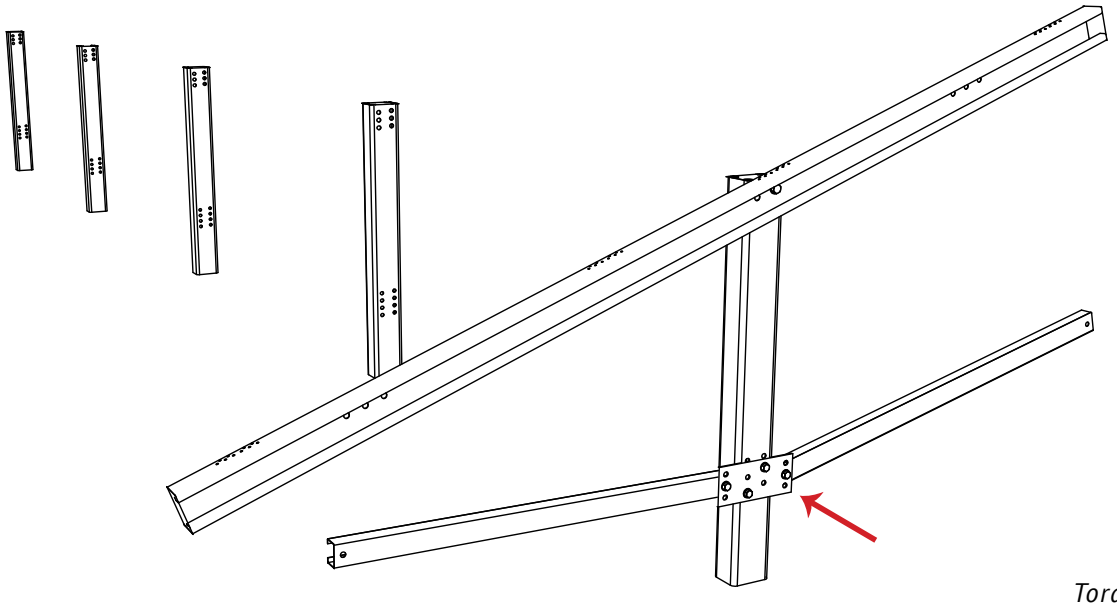


Down 3/4"



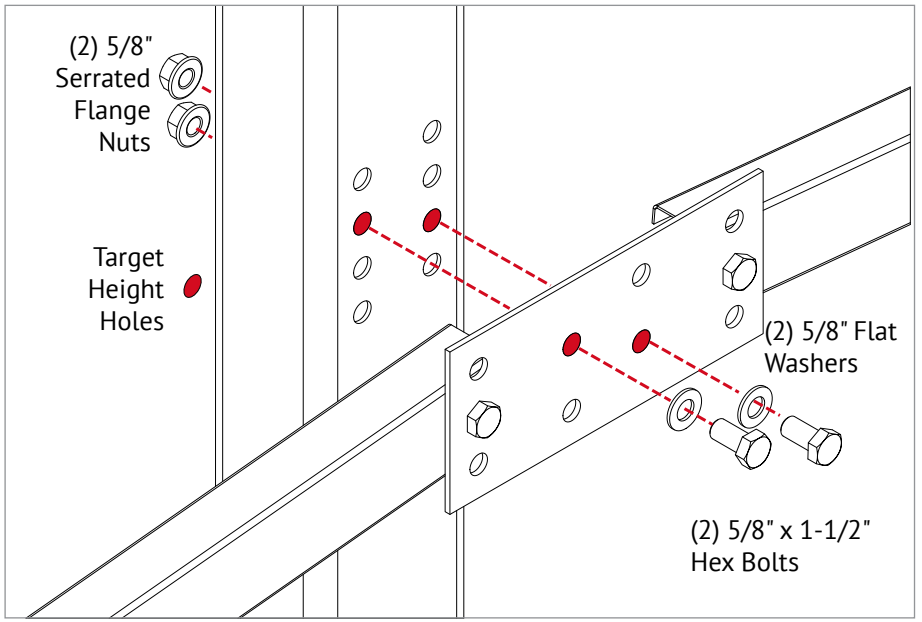
Down 1-1/2"

ATTACH PILE TO DIAGONAL BRACE ASSEMBLY



Diagonal Brace Assembly

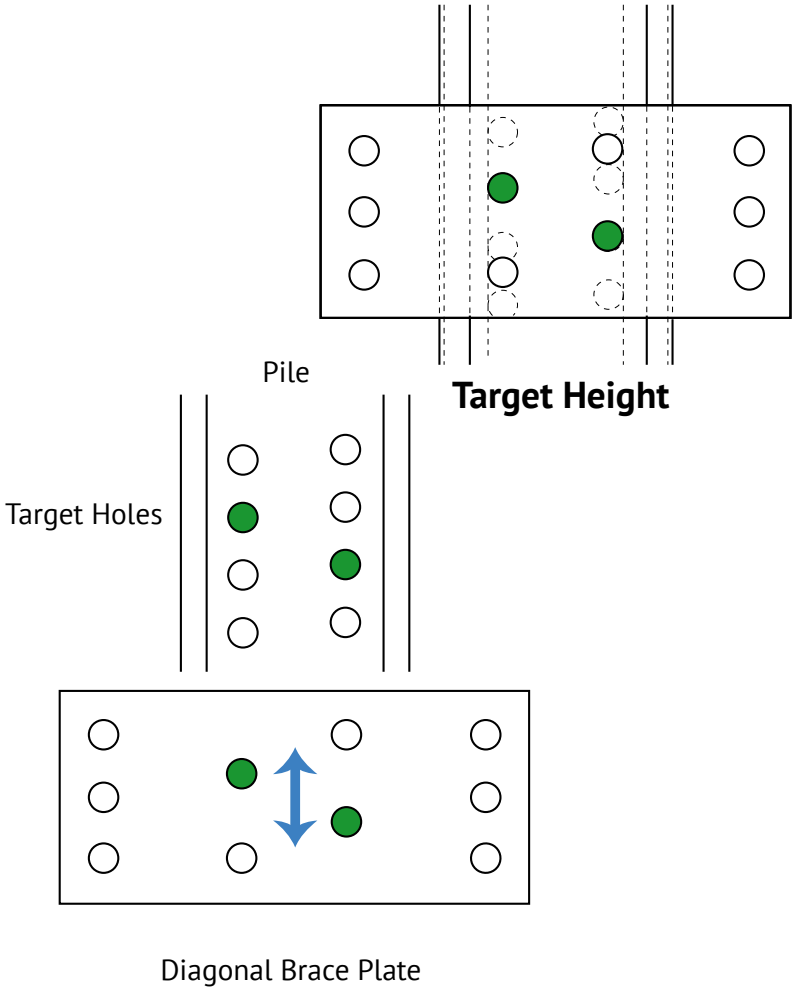
Install hardware snug tight.
Torque per construction drawings after final adjustments.



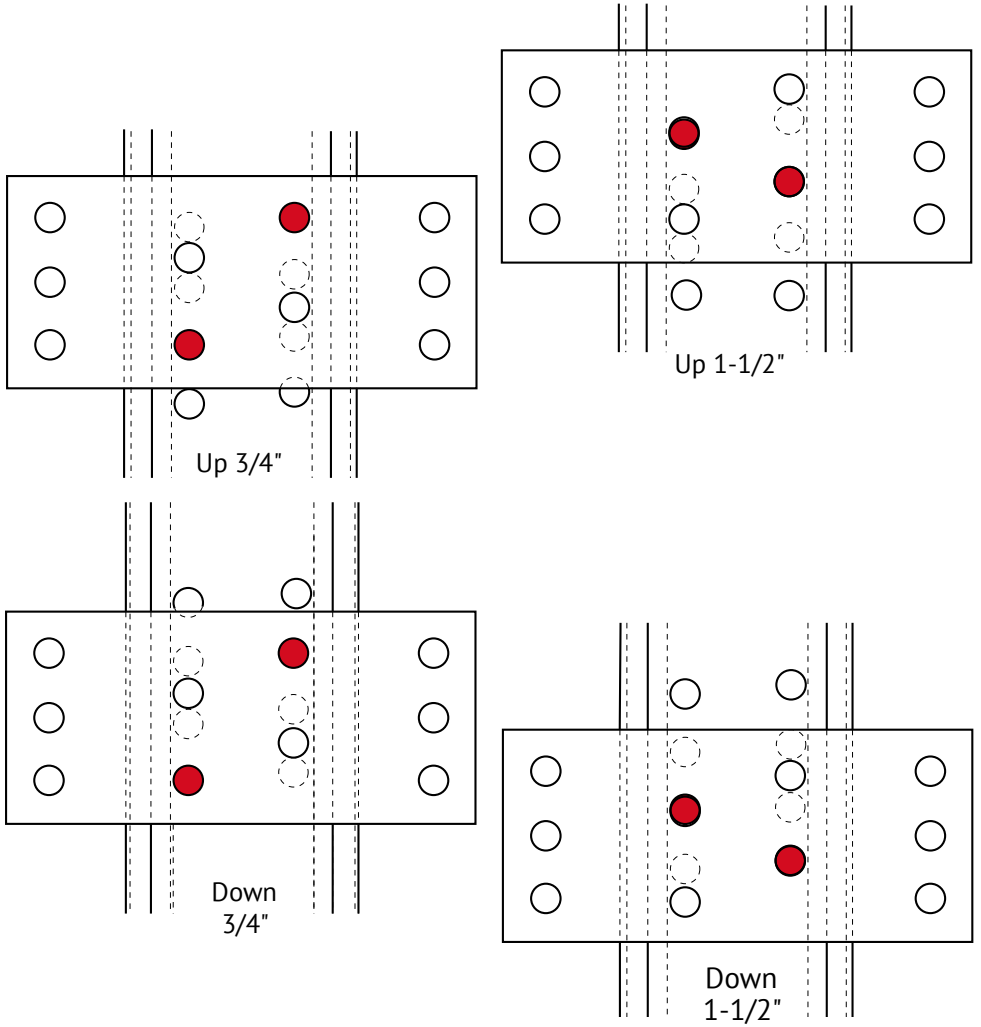
Target Height

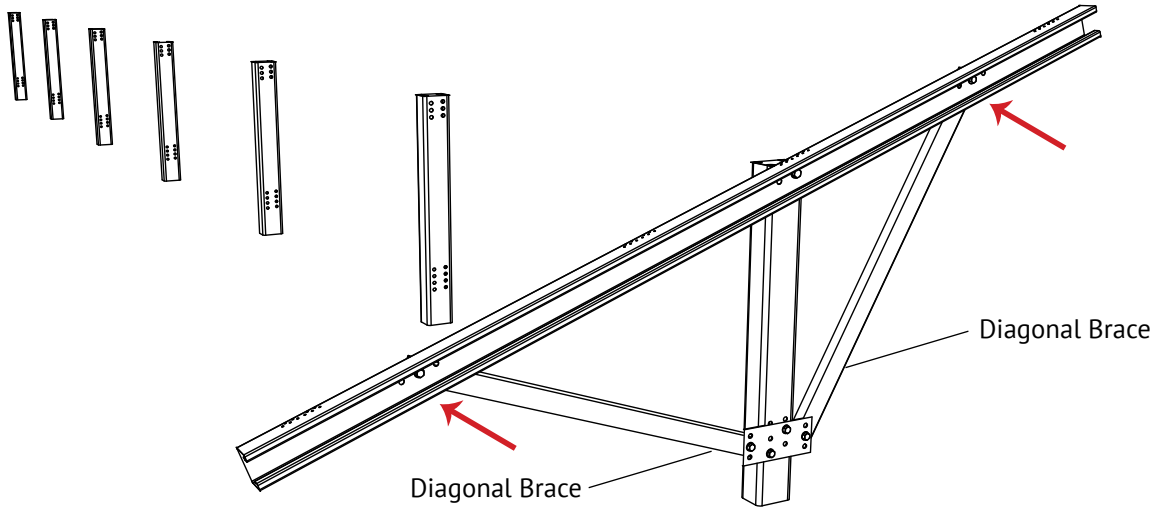
Move diagonal brace plate up or down (not horizontally) as needed to adjust height in 3/4" increments.

Use pair of 5/8" bolts (nuts and washers) at location shown.

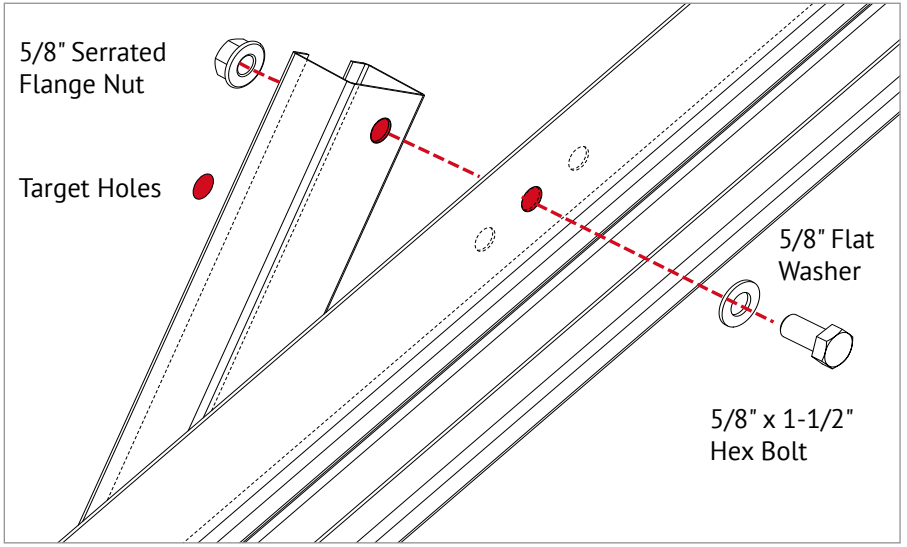


Adjustment Locations (Pair of 5/8" Bolts)

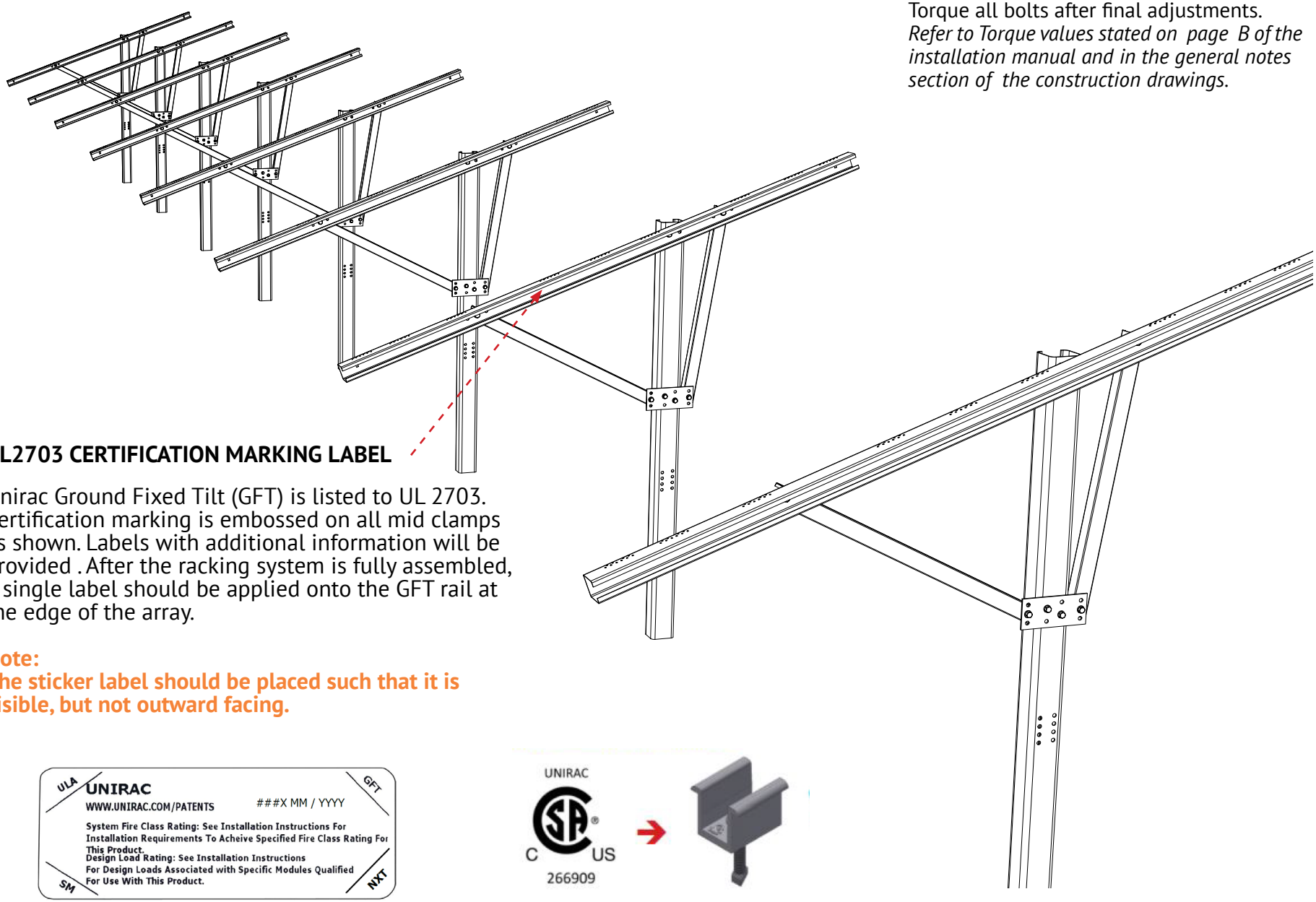




Install hardware snug tight.
Torque per construction drawings after final adjustments.



Torque all bolts after final adjustments.
Refer to Torque values stated on page B of the installation manual and in the general notes section of the construction drawings.

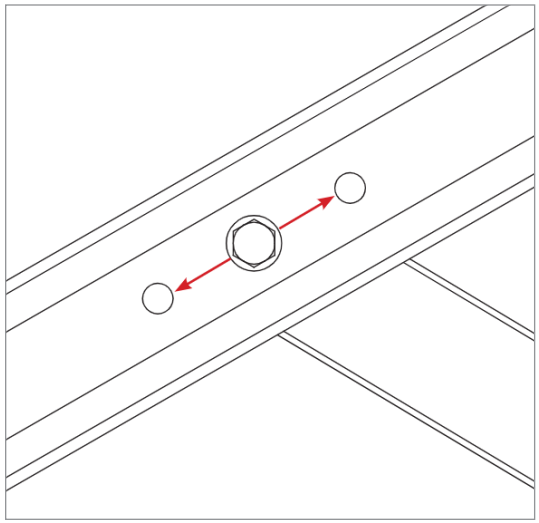


UL2703 CERTIFICATION MARKING LABEL

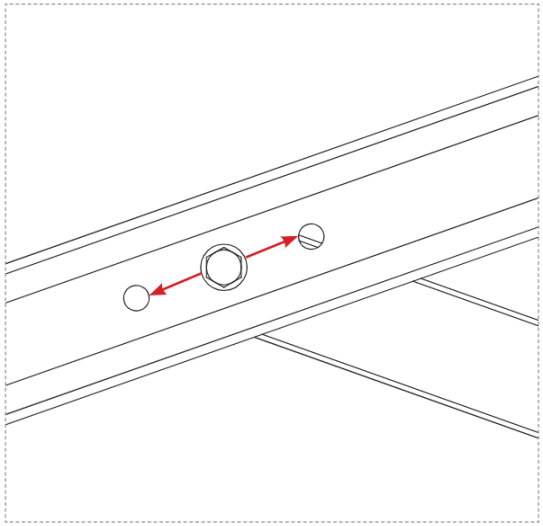
Unirac Ground Fixed Tilt (GFT) is listed to UL 2703. Certification marking is embossed on all mid clamps as shown. Labels with additional information will be provided . After the racking system is fully assembled, a single label should be applied onto the GFT rail at the edge of the array.

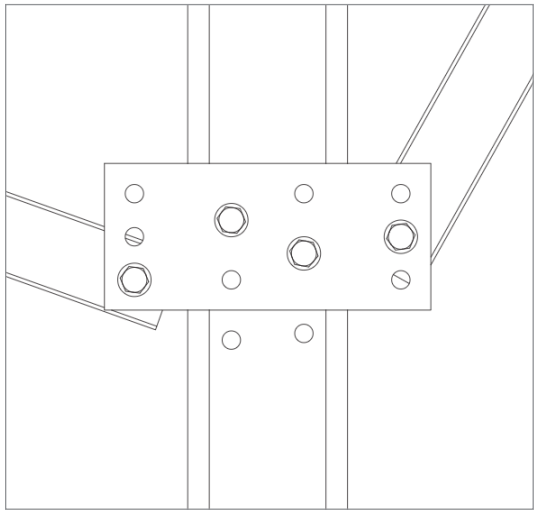
Note:
The sticker label should be placed such that it is visible, but not outward facing.

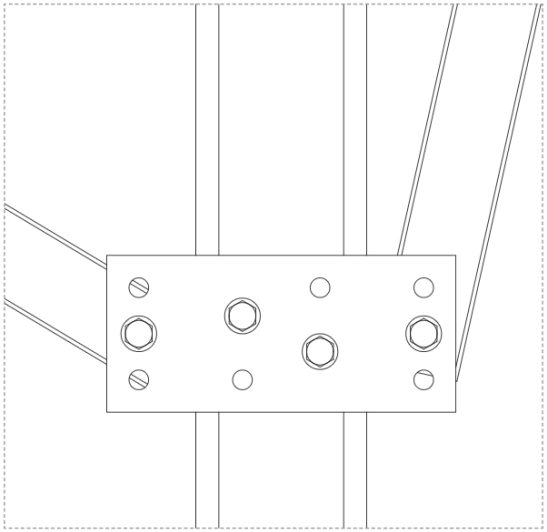
TOP CHORD TILT ADJUSTMENT



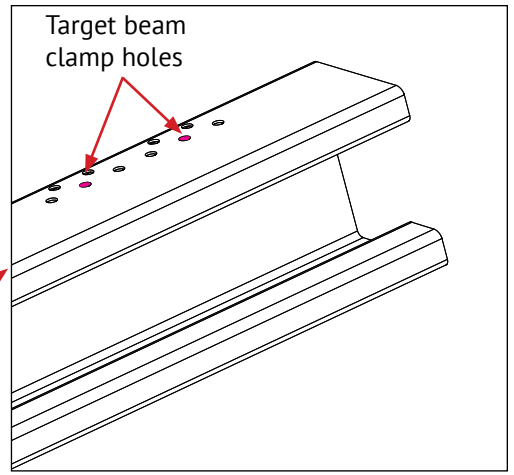
If required, additional minor adjustment of top chord angle may be achieved by a combined repositioning of diagonal braces to adjacent holes in top chord and diagonal brace plate.

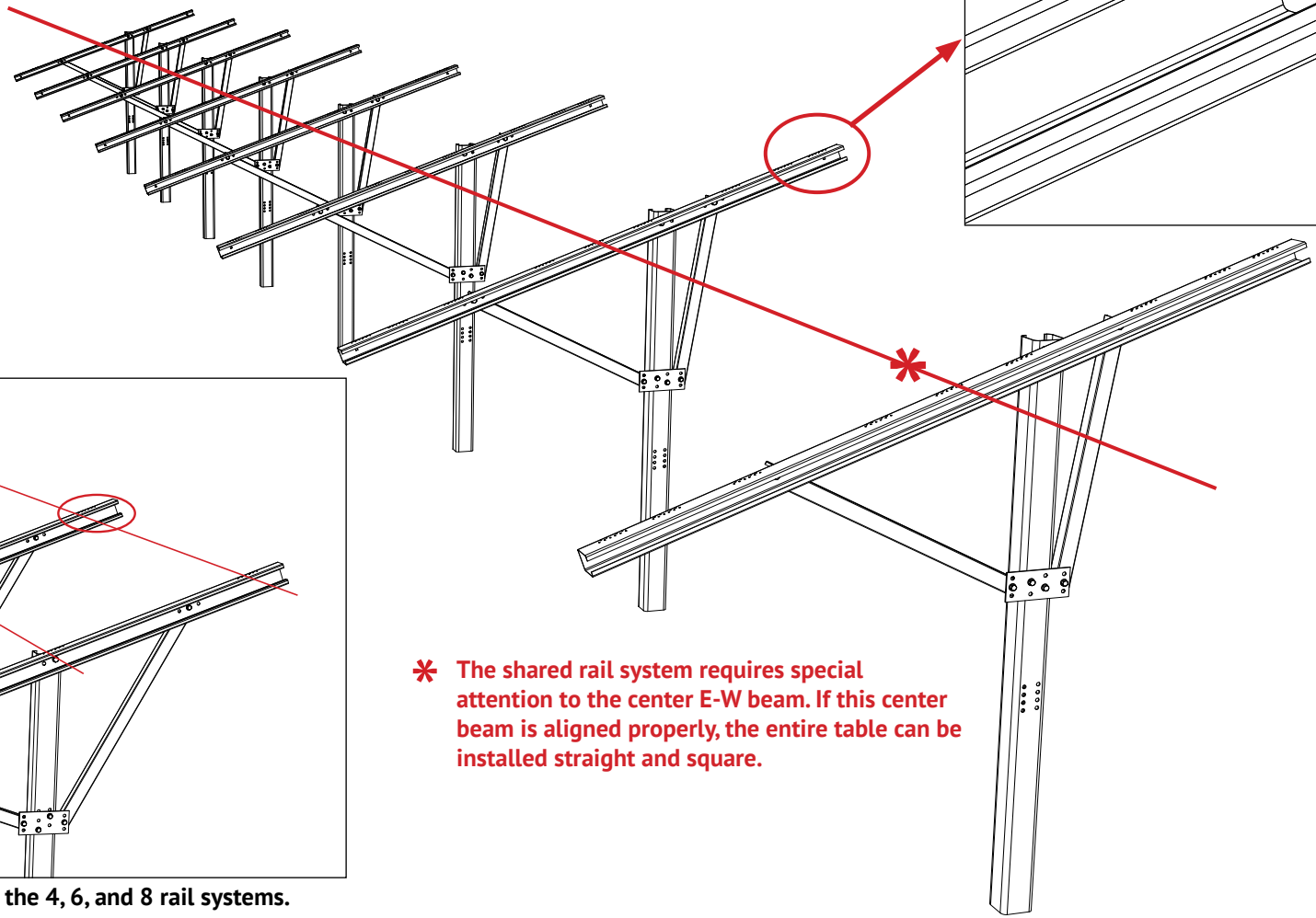






1. Align target hole locations using laser or string line.
2. Determine if adjustments are needed up or down. (Hole patterns allow for +1" adjustment in 1/2" increments per instruction on following pages).
3. 3. Mark holes to be used for attaching E-W beams prior to installing.





Determine hole locations for the 4, 6, and 8 rail systems.

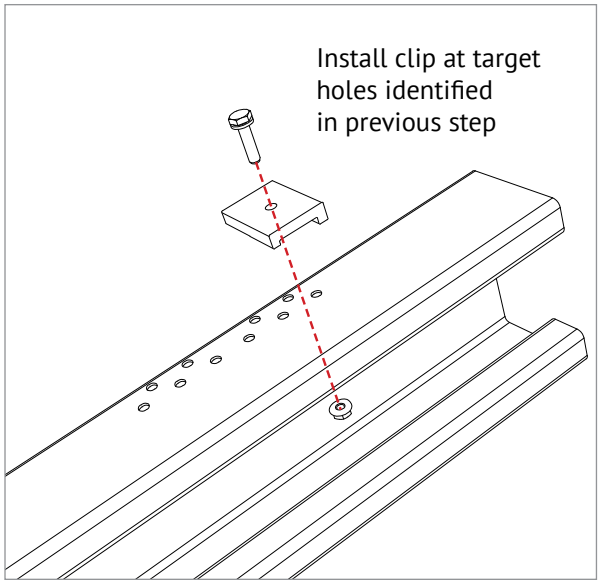
Note: Refer to construction drawings for N-S rail spans.

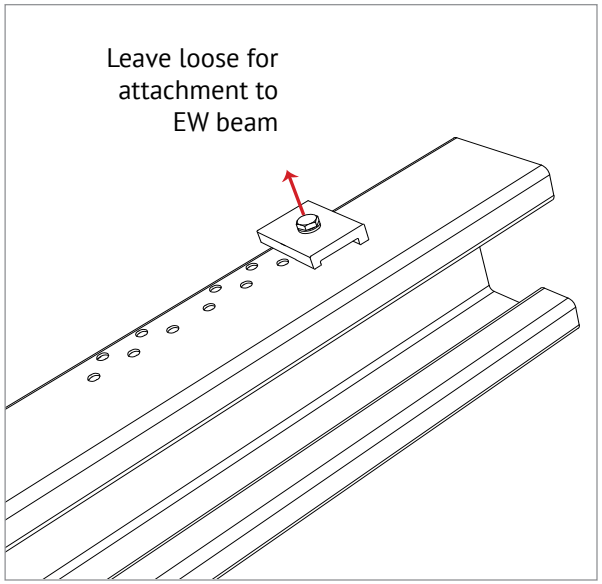
* **The shared rail system requires special attention to the center E-W beam. If this center beam is aligned properly, the entire table can be installed straight and square.**

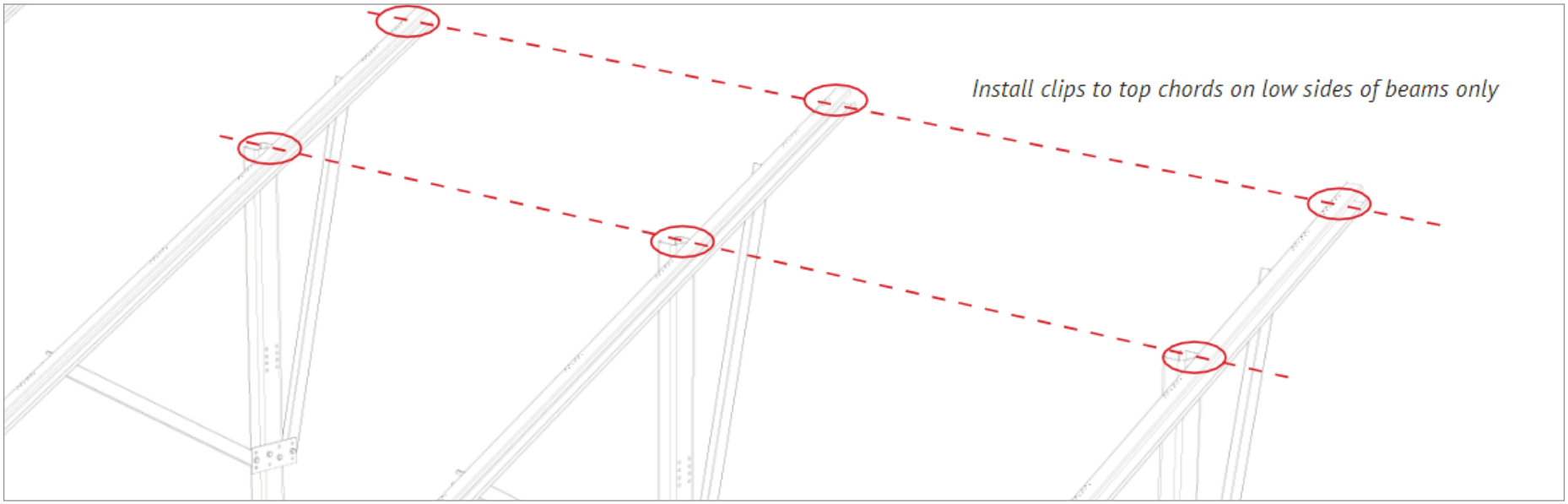
Anti-Seize

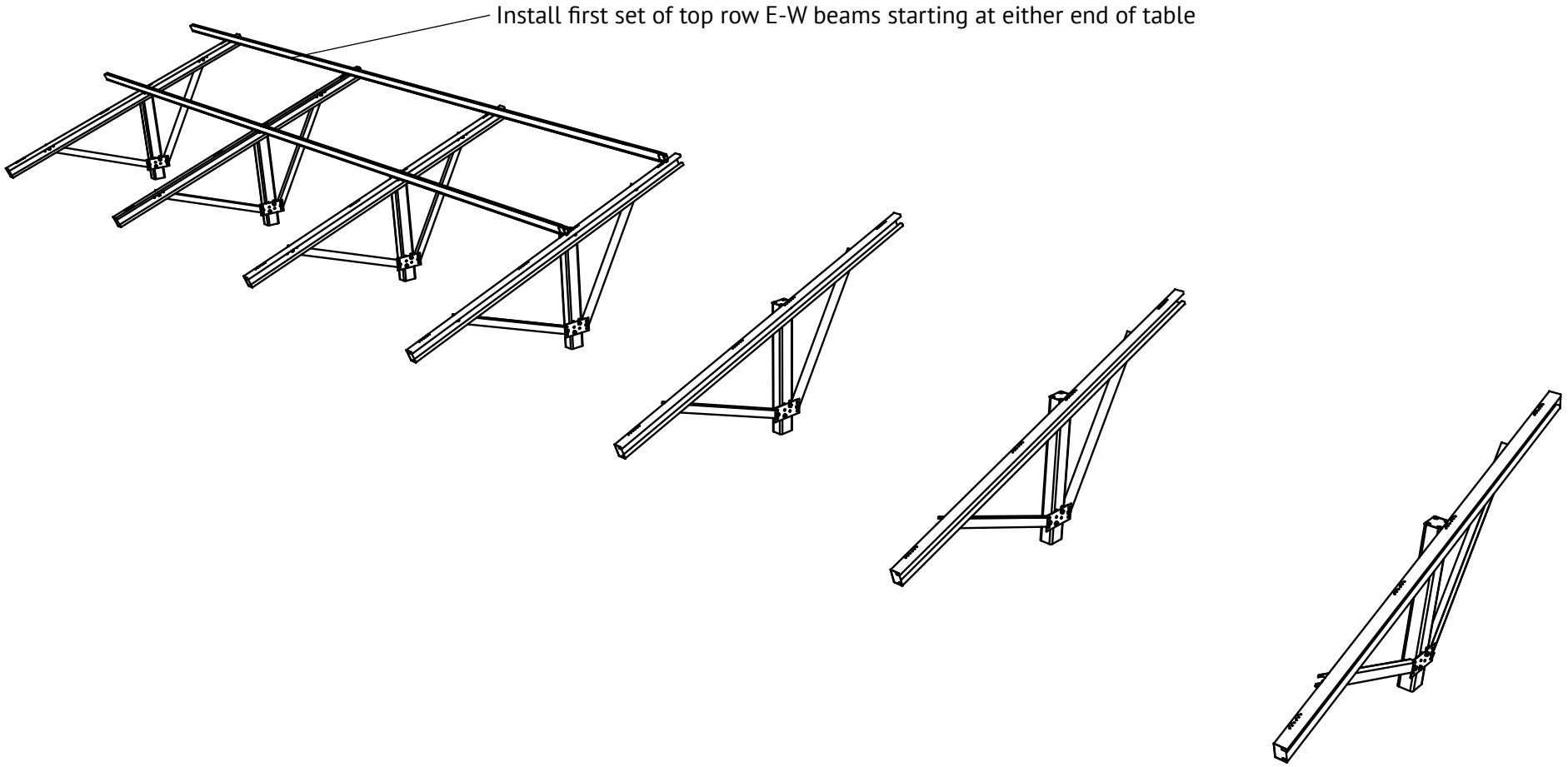
Stainless steel hardware can seize up, a process called galling. To significantly reduce its likelihood:

1. Apply minimal lubricant to bolts only where indicated in installation process, preferably Anti-Seize commonly found at auto parts stores (Anti-seize has been factory applied to mid clamp bolts)
2. Shade hardware prior to installation,
3. Avoid spinning stainless nuts onto bolts at high speed.

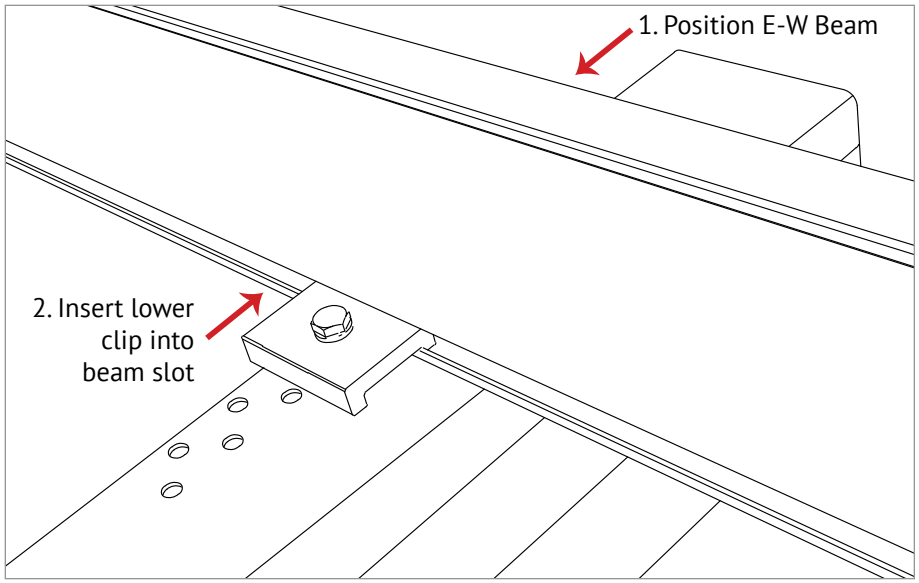


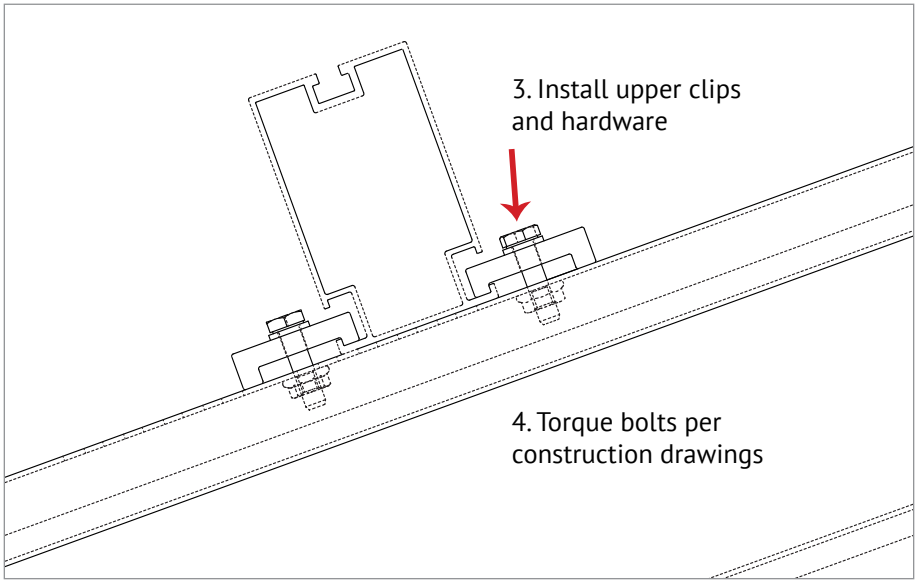


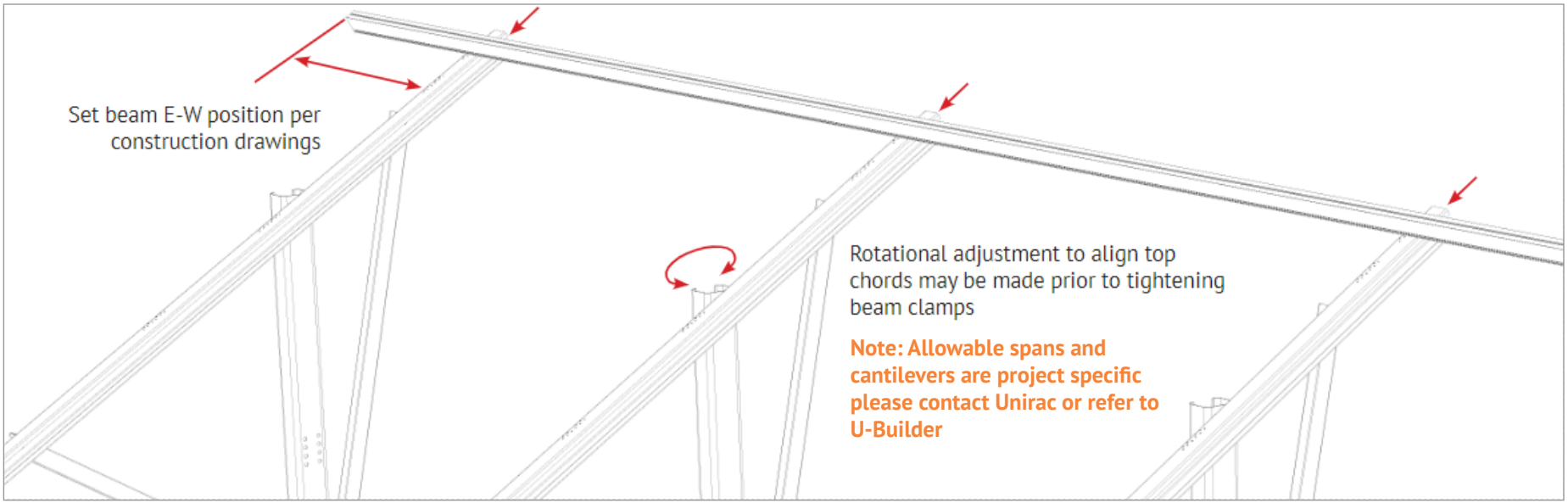


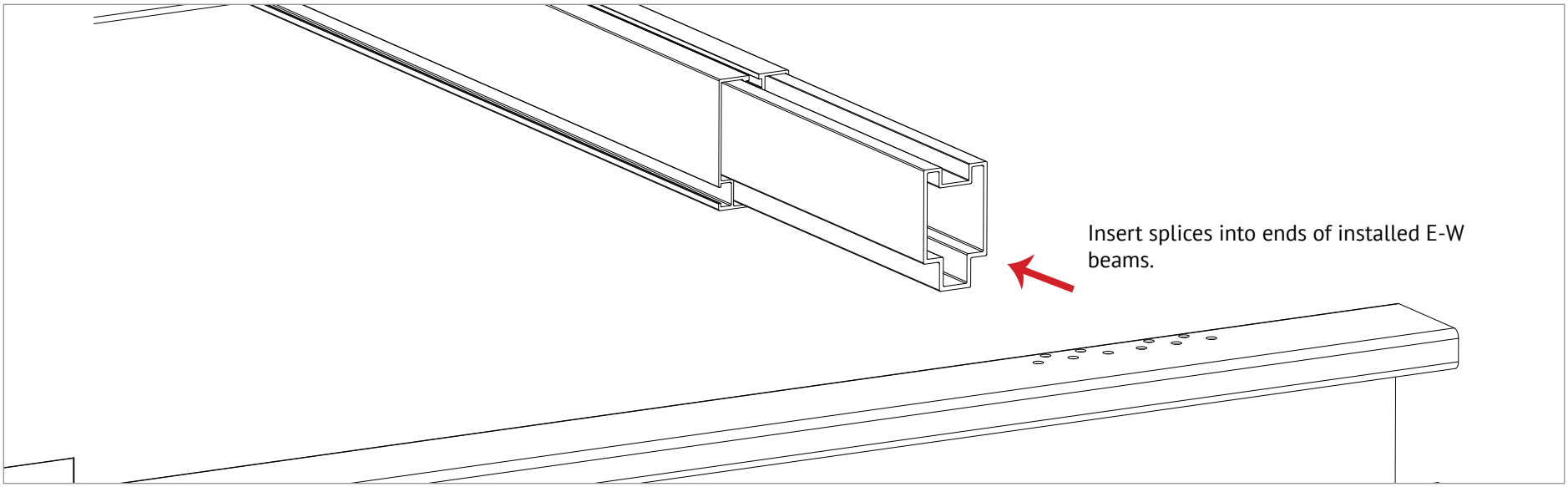

Install first set of top row E-W beams starting at either end of table

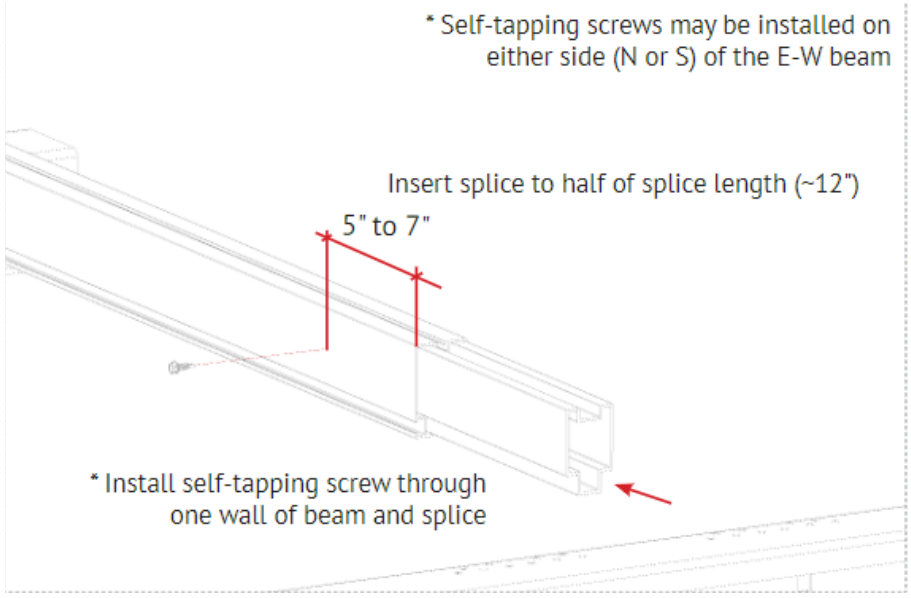
ATTACH E-W BEAMS TO TOP CHORDS

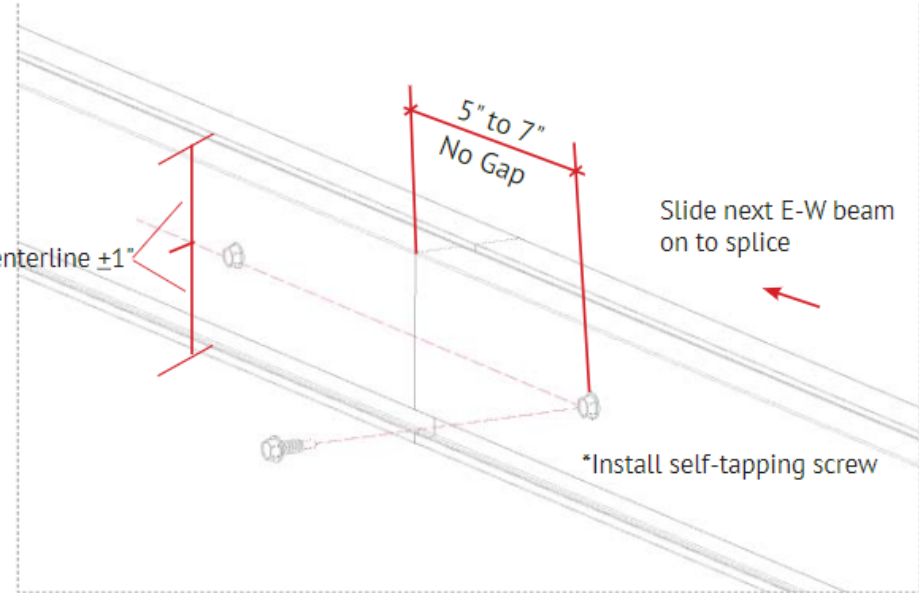


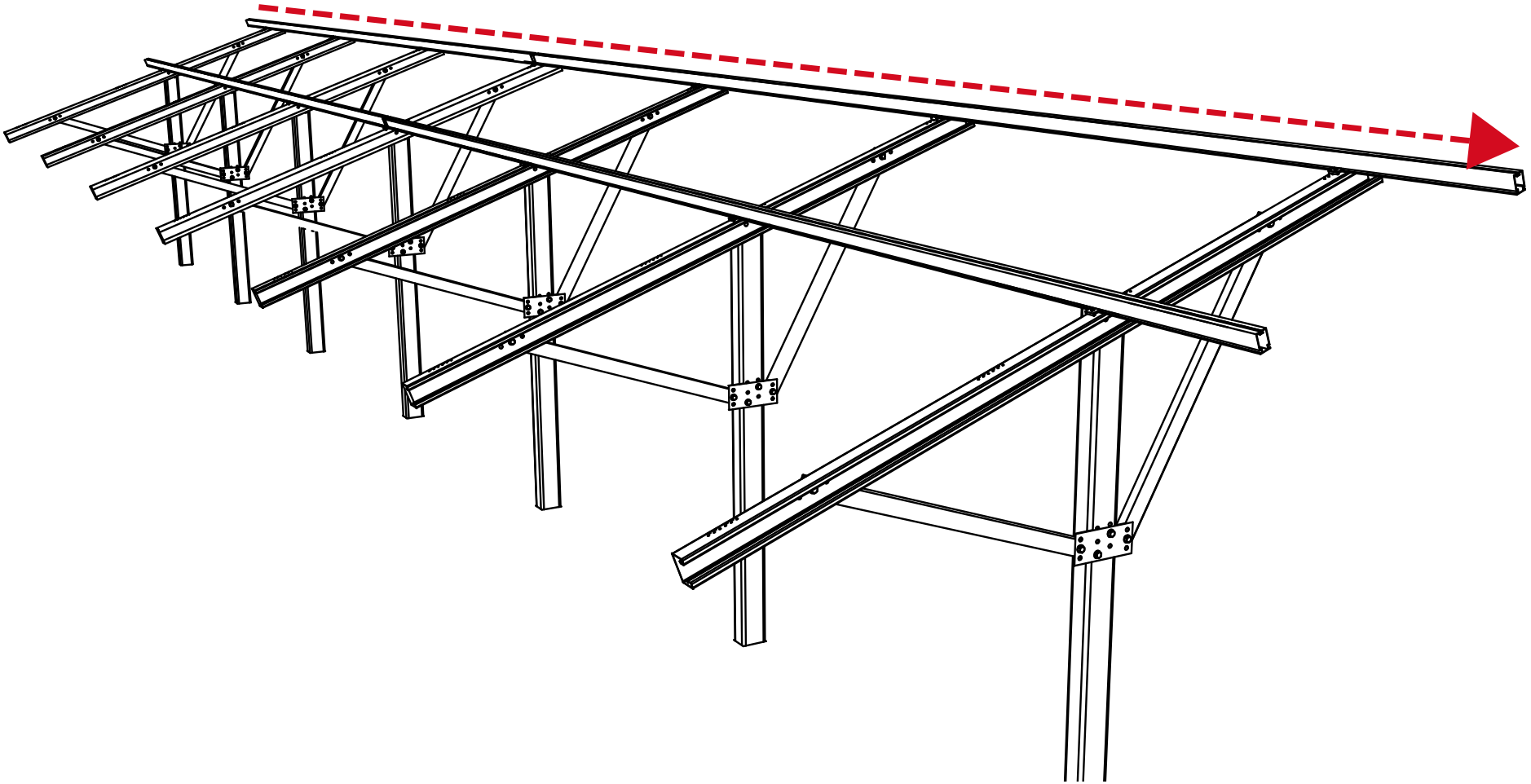


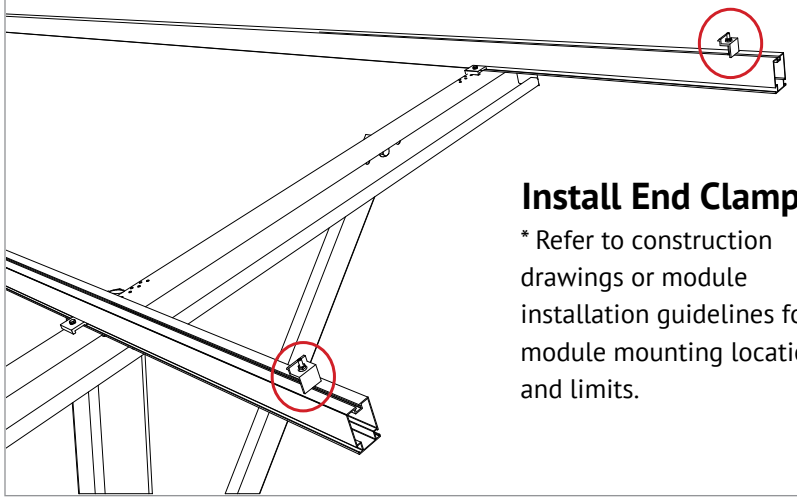



Insert splices into ends of installed E-W beams.


* Self-tapping screws may be installed on either side (N or S) of the E-W beam
Insert splice to half of splice length (~12")
5" to 7"
* Install self-tapping screw through one wall of beam and splice

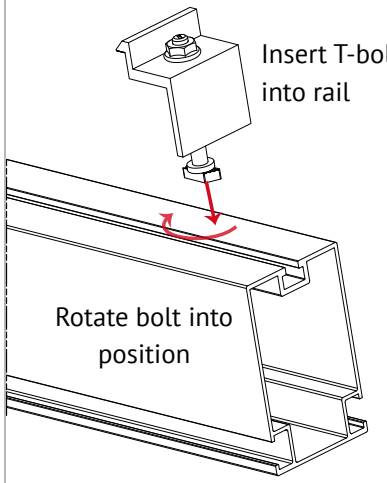

5" to 7"
No Gap
Centerline ±1"
Slide next E-W beam on to splice
*Install self-tapping screw

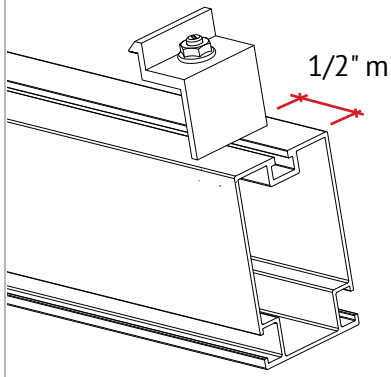


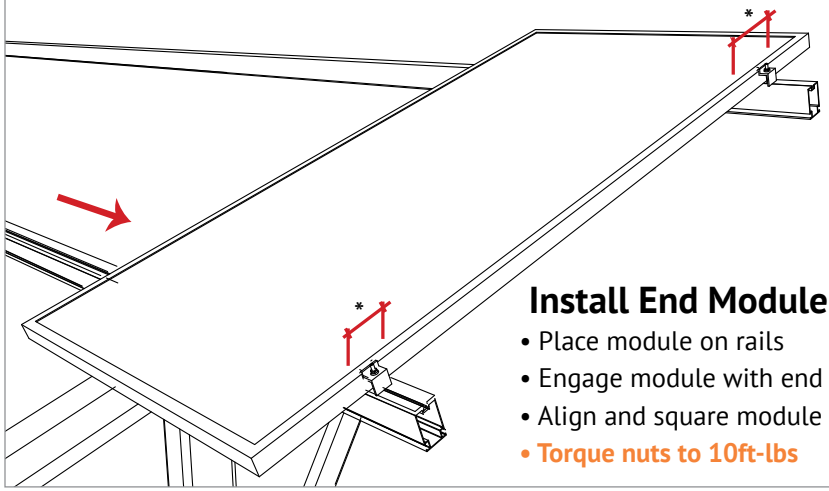


Install End Clamps

* Refer to construction drawings or module installation guidelines for module mounting locations and limits.



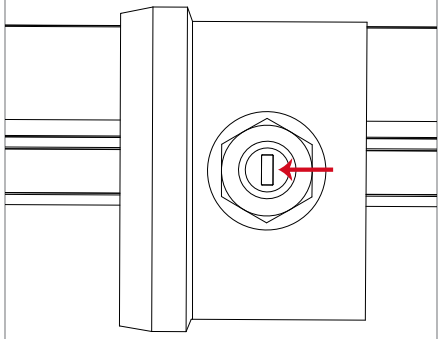




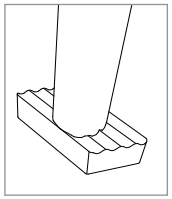
Install End Module

- Place module on rails
- Engage module with end clamps
- Align and square module
- **Torque nuts to 10ft-lbs**

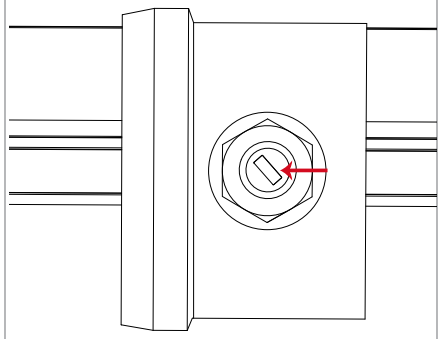
Serrated T- Bolts



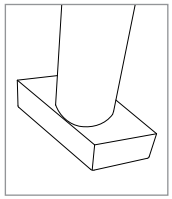
Verify that bolt position indicator is perpendicular to E-W beam



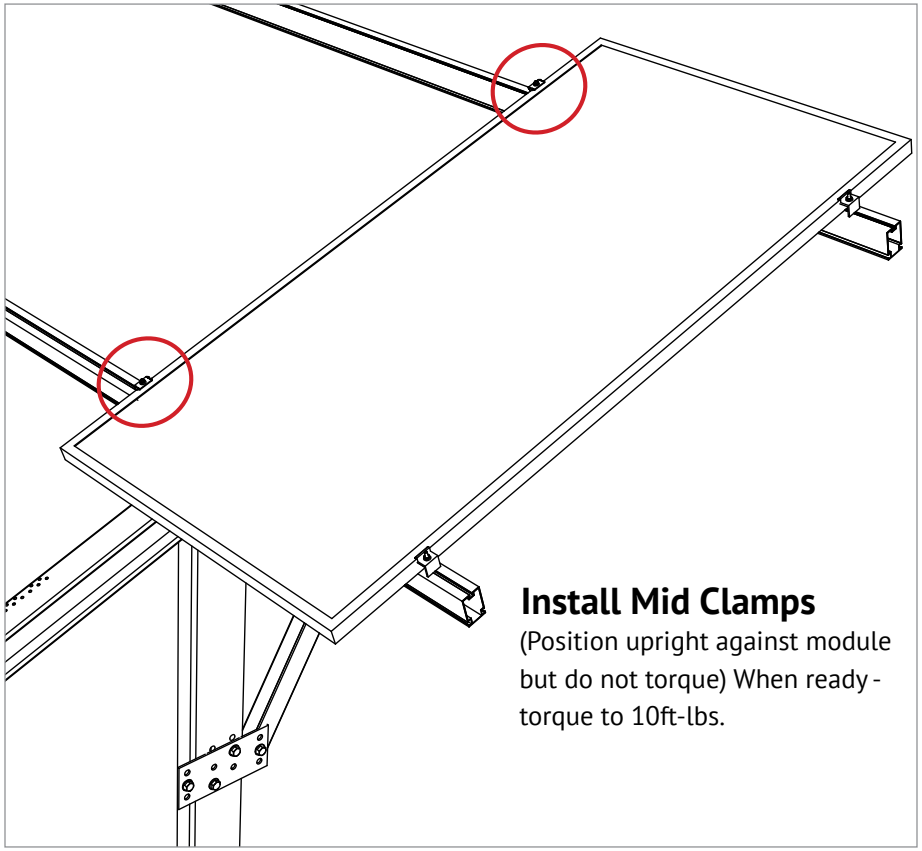
Non-Serrated T- Bolts



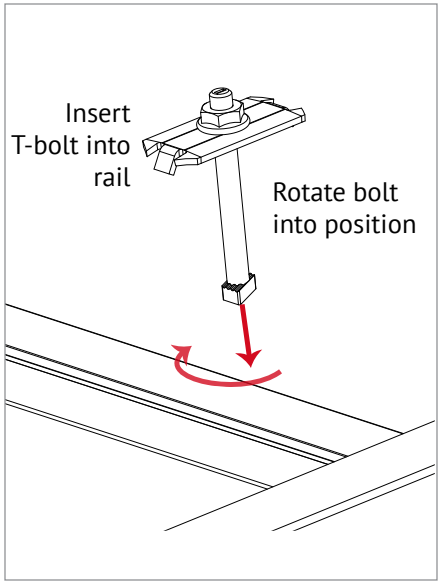
Verify that bolt position indicator is as shown



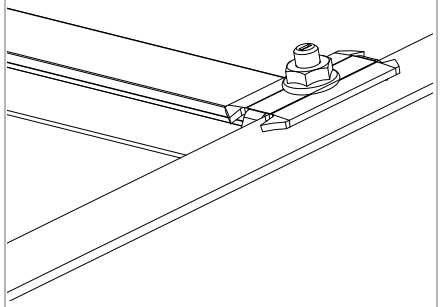
NOTE: *See appendix for different clamp configurations.



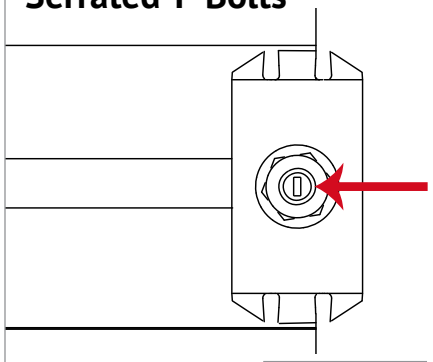
Install Mid Clamps
(Position upright against module but do not torque) When ready - torque to 10ft-lbs.



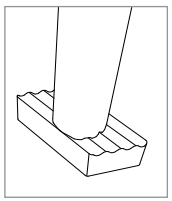
Position clamp on module.
Do not tighten nut until next module is in place.



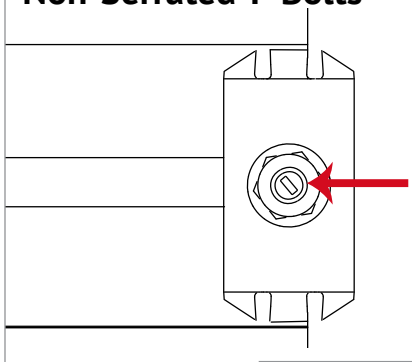
Serrated T- Bolts



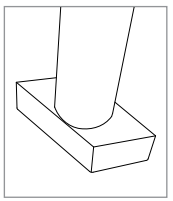
Verify that bolt position indicator is perpendicular to E-W beam



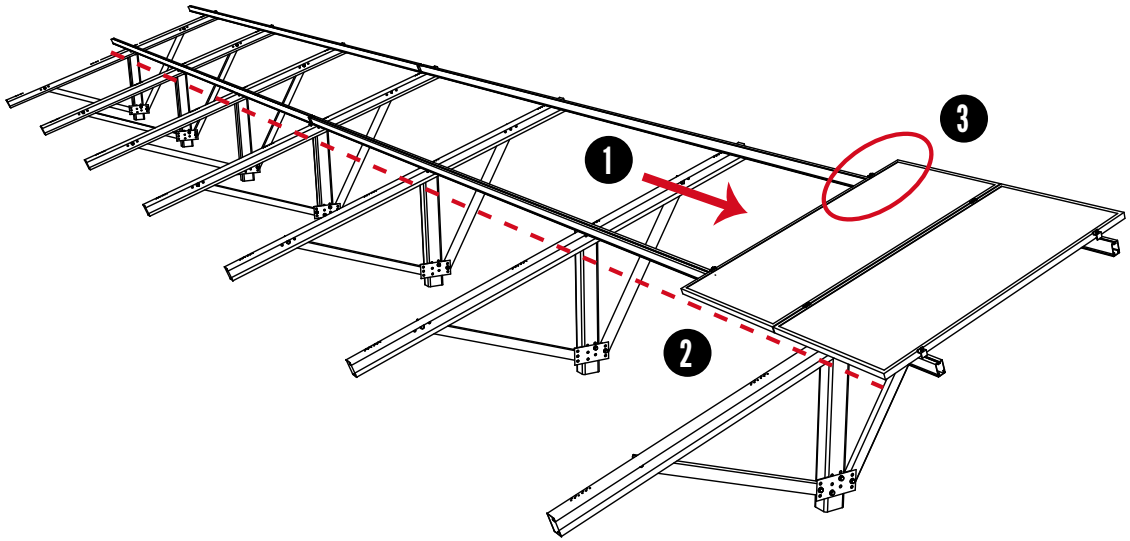
Non-Serrated T- Bolts

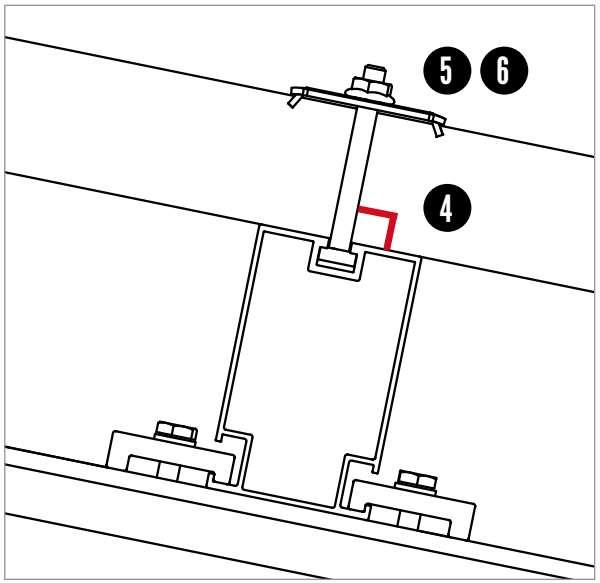


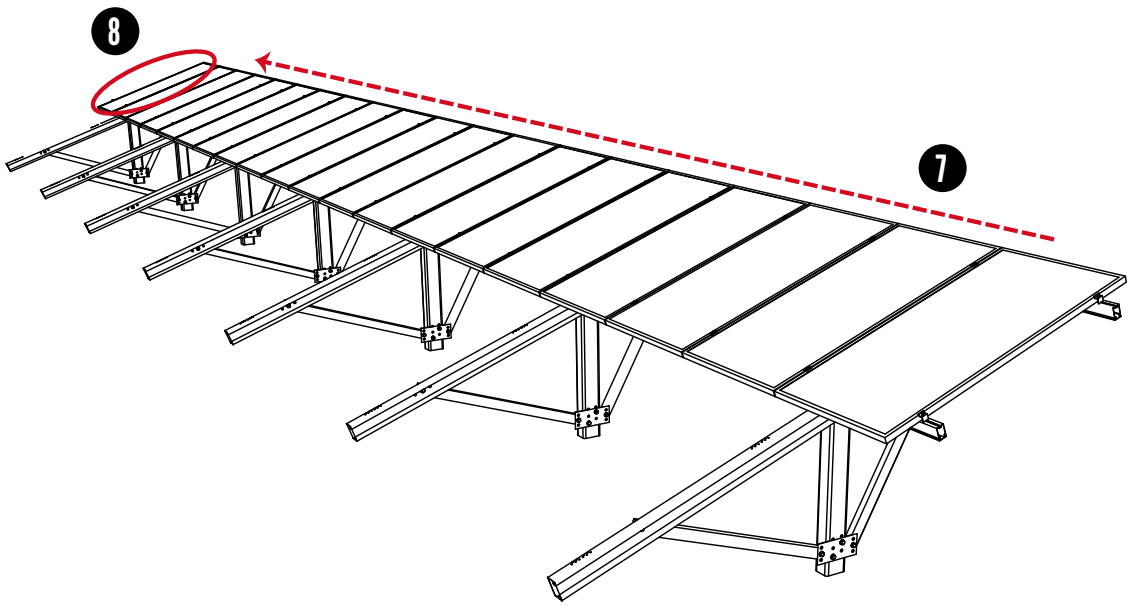
Verify that bolt position indicator is as shown



NOTE: *See appendix for different clamp configurations.

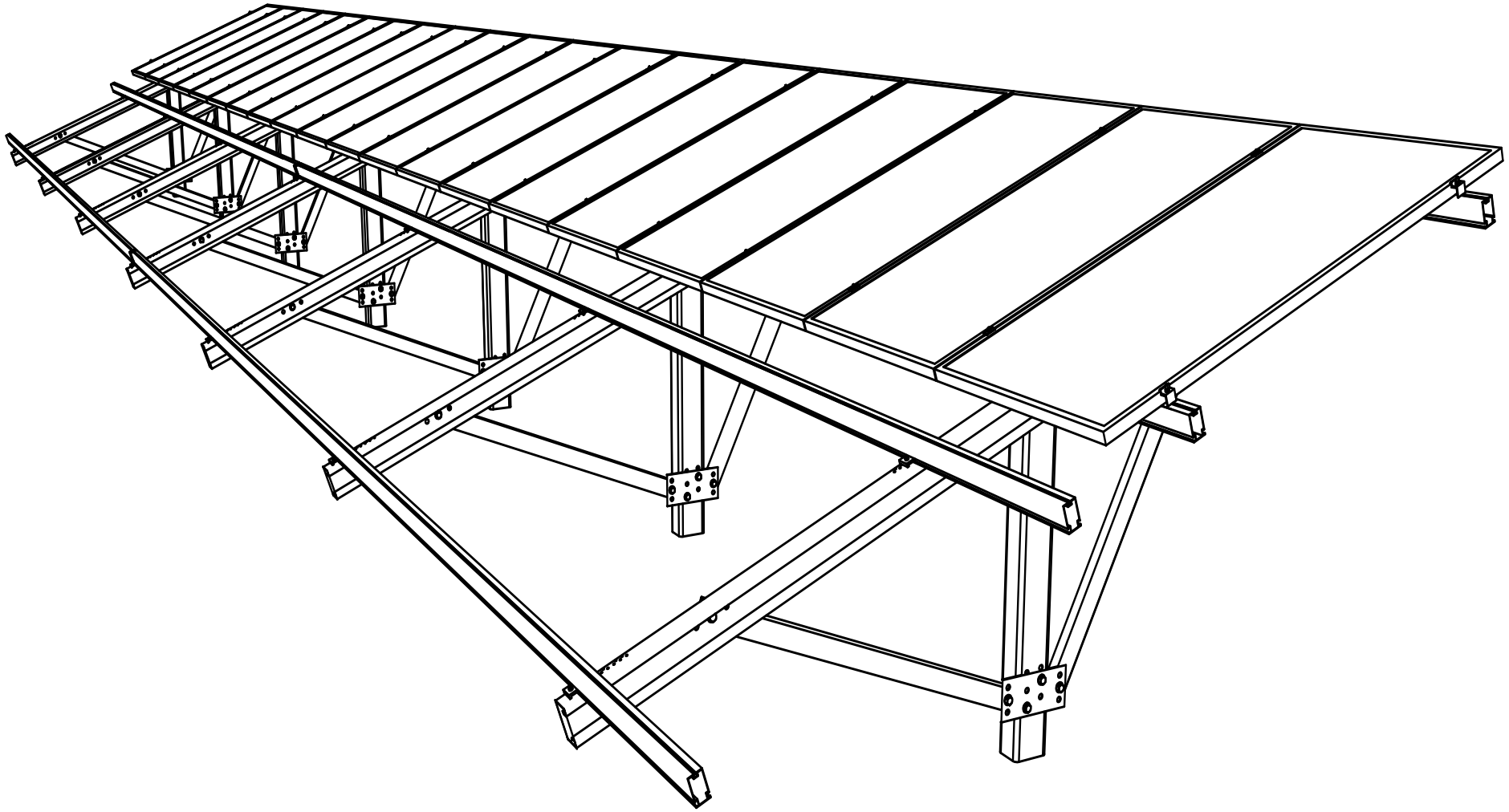


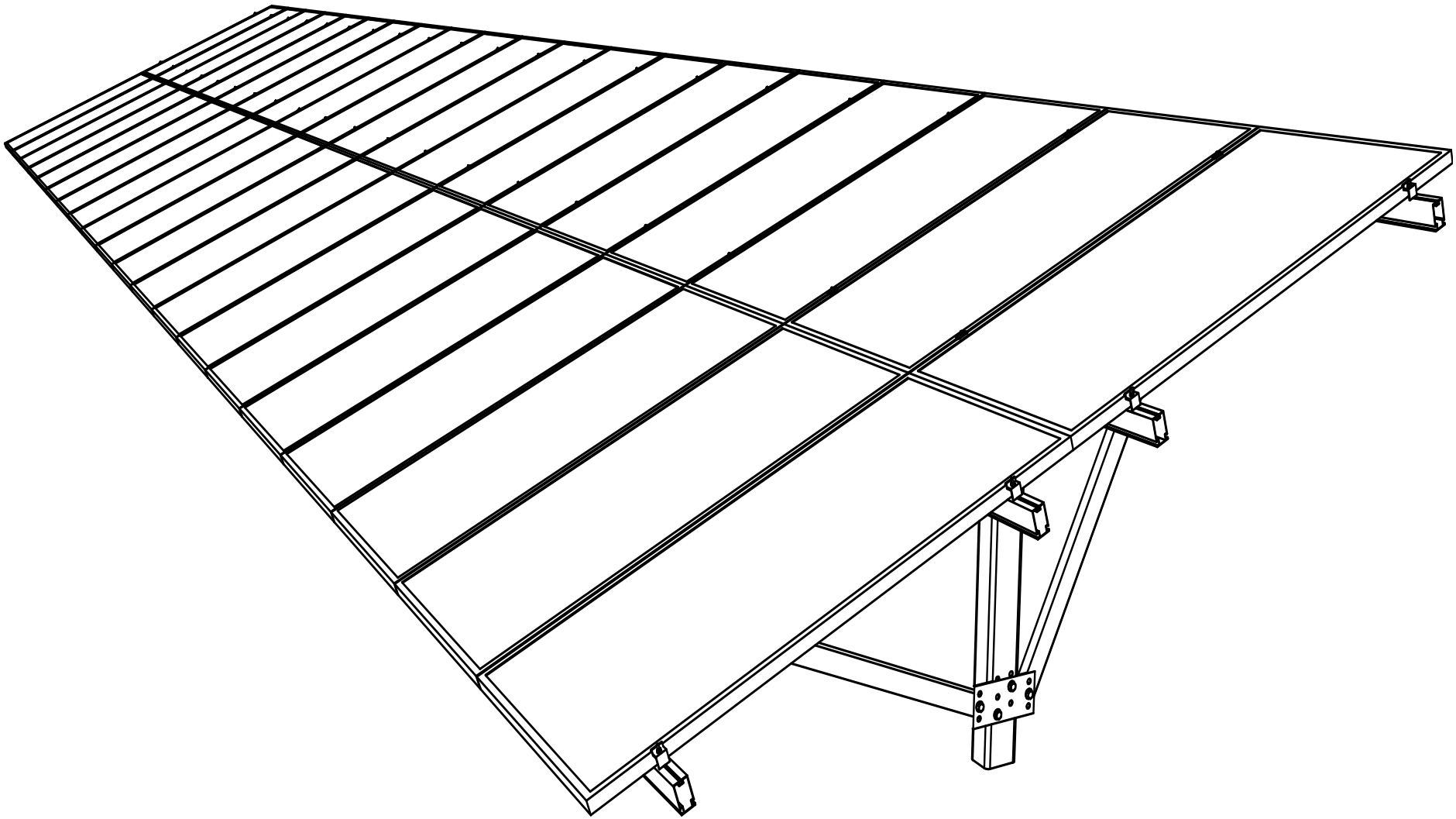


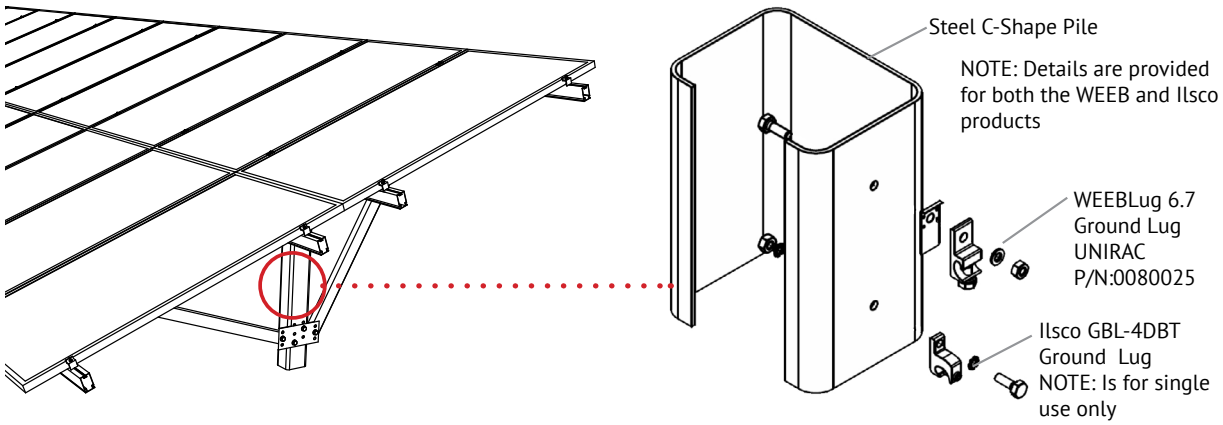


1. Place module on rails and engage with Mid Clamps
2. Align and square modules
3. Verify module gap (1/4")
4. Verify Mid Clamp bolt shafts are perpendicular to rail
5. Verify position of indicator mark on bolt
6. **Torque nuts to 10 ft-lbs**
7. Repeat installation of clamps and modules to complete top row
8. Install End Clamps on last module

NOTE: The GFT system must be periodically re-inspected for loose components, loose fasteners and any corrosion, such that if found, the affected components are to be immediately replaced.







The following grounding & bonding components have been certified to be compatible with Unirac GFT:

- Wiley WEEBLug (P/N 0080025) Torque 1/4" mounting hardware to 10ft-lbs. See product data sheet for conductor size and conductor fastener torque.
- Ilsco Lay-in Lug (P/N GBL-4DBT) Torque 10-32 mounting hardware to 5ft-lbs. See product data sheet for conductor size and conductor fastener torque.

Ground Lug	Bolt size	Drill size
WEEBLug	1/4"-20	17/64"
Ilsco	#10-32	7/31"

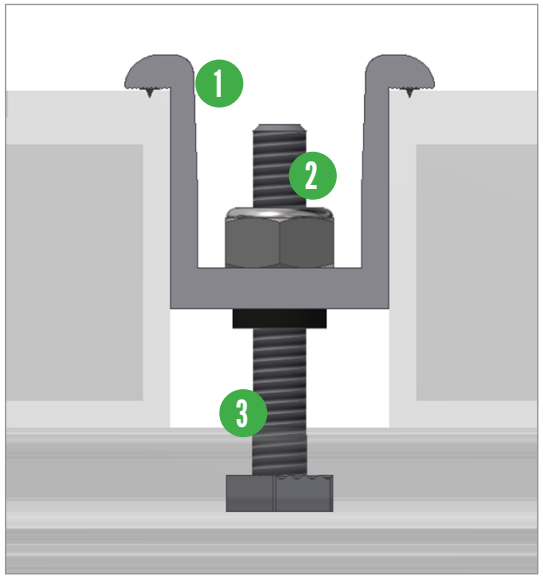
The entire Unirac GFT table has been classified for grounding & bonding to UL2703. The bonding path has been evaluated from the PV module frame all the way through to the pile. The following are suggestions to aid in grounding of the table for the project electrical engineer of record, and by the local authority having jurisdiction. This racking system may be used to ground and/or mount a PV module complying with UL1703 only when the specific module has been evaluated for grounding and/or mounting in compliance with the included instructions.

GROUND LUG MOUNTING DETAILS

Details are provided for both the WEEB and Ilsco products. The WEEB Lug has a grounding symbol located on the lug assembly. The Ilsco lug has a green colored set screw for grounding indication purposes. One lug is recommended per GFT table. Installation must be in accordance with NFPA NEC70, however the electrical designer of record should refer to the latest revision of National Electrical Code (NEC) for actual grounding conductor cable size. Unirac GFT is intended to be used with PV modules that have a system voltage less than or equal to that allowable by NEC. A minimum 10AWG, 105°C copper grounding conductor should be used to ground the system according to the (NEC) and the authority having jurisdiction. It is the installer responsibility to check local codes, which may vary.

NOTE:

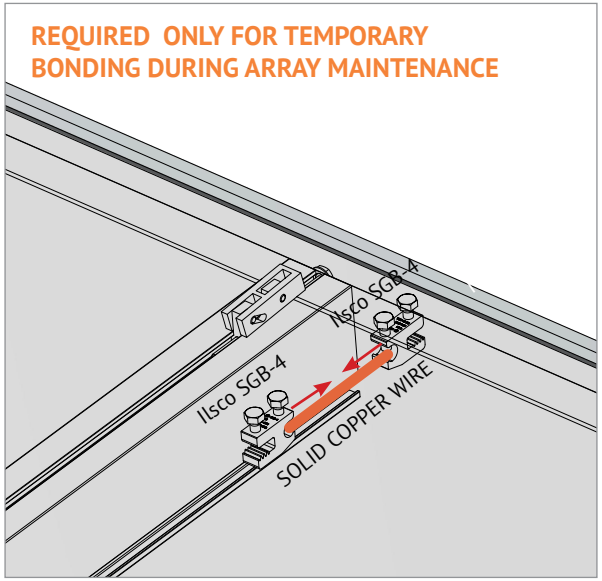
- **Any holes drilled to attach the ground lugs should be de-burred before use.**
- **All Unirac module clamps and the Ilsco GBL-4DBT ground lug are single use. All other GFT components are multiple use.**
- **Isolate copper from aluminum contact to prevent corrosion.**
- **The SM Grounding Lug is an alternative method to ground the system, and refer the reader to Appendix C**



BONDING MIDCLAMP ASSEMBLY

1. Aluminum mid clamp with stainless steel bonding pins that pierce module frame anodization to bond module to module through clamp
2. Stainless steel nut bonds aluminum clamp to stainless steel T-bolt
3. Serrated T-bolt head penetrates rail anodization to bond T-bolt, nut, clamp, and modules to SM rail

NOTE: All Unirac mid clamps and the UAF end clamp shown in this install guide are bonding clamps



TEMPORARY BONDING CONNECTION DURING ARRAY MAINTENANCE

When removing modules for replacement or system maintenance, any module left in place that is secured with a bonding Midclamp will be properly grounded. If a module adjacent to the end module of a row is removed or if any other maintenance condition leaves a module without a bonding mid clamp, a temporary bonding connection must be installed as shown

- Attach Ilsco SGB4 to wall of GFT rail
- Attach Ilsco SGB4 to module frame
- Install solid #6 AWG copper wire jumper to Ilsco lugs

ELECTRICAL CONSIDERATIONS

GFT is intended to be used with PV modules that have a system voltage less than or equal to that allowable by NEC. For standard system grounding a minimum 10AWG, 105°C copper grounding conductor should be used to ground a system, according to the National Electric Code (NEC). It is the installer's responsibility to check local codes, which may vary. See below for interconnection information.

INTERCONNECTION INFORMATION

There is no size limit on how many GFT & PV modules can be mechanically interconnected for any given configuration, provided that the installation meets the requirements of applicable building and fire codes.

GROUNDING NOTES

The installation must be conducted in accordance with the National Electric Code (NEC) and the authority having jurisdiction. Please refer to these resources in your location for required grounding lug quantities specific to your project.

The grounding / bonding components may overhang parts of the array so care must be made when walking around the array to avoid damage.

Conductor fastener torque values depend on conductor size. See product data sheets for correct torque values.

Mid clamps do not need to be repositioned for reuse.

The GFT system has been certified and listed to the UL 2703 standard (Rack Mounting Systems and Clamping Devices for Flat-Plate Photovoltaic Modules and Panels). This standard included electrical grounding, electrical bonding, mechanical load and fire resistance testing.

In conducting these tests, specific modules are selected for their physical properties so that the certifications can be broadly applied. The following lists the specific modules that were tested and the applicability of those certifications to other modules that might come onto the market. PV modules may have a reduced mechanical load rating, independent of the GFT load rating. Please consult the PV module manufacturer's installation guide for more information.

In addition to UL 2703 certification, Unirac performs internal testing beyond the requirements of certification tests in order to establish system functional limits, allowable loads, and factors of safety. These tests include functional system tests, and destructive load testing.

MECHANICAL LOAD TEST MODULES

The modules selected for UL 2703 mechanical load testing were selected to represent the broadest range possible for modules on the market. The tests performed cover the following basic module parameters:
Frame thicknesses greater than or equal to 1.0 mm
Basic single and double wall frame profiles (some complex frame profiles could require further analysis to determine applicability)
Clear and dark anodized aluminum frames`

Tested Modules			
Module Manufacturer	**Model/Series**	**Area [sqft]**	**UL2703 Certification Load Ratings**
Hyundai	HiS-S325TI	21.06	Down– 113 PSF, Up – 50 PSF Down-Slope – 15 PSF
SunPower	SPR-P19-395-COM	22.20	Down– 113 PSF, Up – 50 PSF Down-Slope – 15 PSF
First Solar	FS-6xxx-P	27.12	Down– 33.9 PSF, Up – 33.9 PSF Down-Slope – 16.5 PSF
Q Cells	Q Peak Duo XL-G11.3/BFG	29.49	Down: 31.18 PSF, Up: 31.18 PSF, Down-Slope: 9.8 PSF
Trina	TSM-DEG21C.20	33.43	Down: 27.79 PSF, Up: 28.05 PSF, Down-Slope: 9.8 PSF

Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the GROUND FIXED TILT system.

Manufacture	Module Model / Series
Aionrise	AION60G1, AION72G1
Aleo	P-Series & S-Series
AMPS	AMPS-xxxN-108BB AMPS-xxxP-54BB
Aptos Solar	DNA-108-(MF/BF)10-xxxW DNA-108-MFN10-xxxW DNA-120-(MF/BF)10-xxxW DNA-120-(MF/BF)23 DNA-120-(MF/BF)26 DNA-120-MF10 DNA-144-(MF/BF)23 DNA-144-(MF/BF)26 DNA-144-BF10-xxxW-DG
Astronergy	ASM6612P Series CHSM6612 M, M/HV CHSM6612P/HV Series CHSM6612P Series CHSM66M(DG)/F-BH CHSM72M(DG)/F-BH CHSM72M-HC CHSM72N(DG)/F-BH
Auxin	AXN10Mxxx AXN6M610T AXN6M612T AXN6P610T AXN6P612T AXNG1M SERIES
Axitec	AC-xxx(M/P)/60S, AC-xxx(M/P)/72S AC-xxxMBT/144V AC-xxxMH/120(S/V/SB/VB)

Manufacture	Module Model / Series
Axitec(Cont.)	AC-xxxMH/144(S/V/SB/VB) AC-xxxP/156-60S AC-xxxTGB/108BB AC-xxxTGB/144TS AC-xxxTGB/144WS-US AC-xxxTGB/96BB
Bila Solar	AA550US-6x24GG
Bluesun Solar	HEX5 BSMxxxM10-54HPH BSMxxxM10-72HBD
Boviet	BVM6610, BVM6612 BVM6610M-xxxS-H-HC BVM6610M-xxxS-H-HC-BF BVM6612M-XXXS-H-HC-BF-DG BVM7612M-H-HC-BF-DG
BYD	P6K & MHK-36 Series
Canadian Solar	CCS6W-xxx-TB-AG CS3K-(MB/MB-AG/MS/P/P HE/PB-AG) CS3L-(MS/P), CS3N-MS CS3U-(MB/MB-AG/MS/P/P HE/PB/PB-AG) CS6.1-54TM-H CS6.1-60TM-H CS6.1-72TB-H CS3W-(MB-AG/MS/P/P-PB-AG) CS3Y-MB-AG, CS5A-M CS6.2-48TM-xxxH CS6.2-66TB-xxxH CS6.2-66TB-xxxHR CS6K-(M/MS/MS AllBlack/P/P HE) CS6P-(M/P) CS6R-MS CS6R-xxxMS-HL

Manufacture	Module Model / Series
Canadian Solar(Cont.)	CS6U-(M/P/P HE) CS6W-(MS/MB-AG) CS6X-P CS7L-MB-AG CS7L-TB-AG CS7N-xxxMB-AG CS7N-xxx MS CS7N-xxxTB-AG CSX-P ELPS CS6(A/P)-MM S1(H/K/U/Y)-MS
Centrosolar America	C-Series & E-Series
CertainTeed	CT2xxMxx-01 CT2xxPxx-01 CT54M10XXX-N07 CT72M10XXX-N07 CTM10400HC11-06 CTM10400HC11-08 CTM10400HC11-09 CTTCxxxHC12-08 CTxxxHC11-04 CTxxxHC11-06 CTxxxMxx-01 CTxxxMxx-02 CTxxxMxx-03 CTxxxMxx-04 CTxxxPxx-01
Eco Solargy	Orion 1000 & Apollo 1000
EMMVEE	ExxxHCBG144-T ExxxHCBT144-T

The modules selected for UL 2703 bonding and grounding testing represent the broadest possible range of modules on the market. The tests were performed for each specific bonding location using representative module frame profile sections. The tests performed cover the following basic module parameters:

- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
- Use with a maximum over current protection device OCPD of 30A
- Unless otherwise noted, all modules listed above include all wattages and specific models within that series. Variable wattages are represented as "xxx"
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Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the GROUND FIXED TILT system.

Manufacture	Module Model / Series
EMMVEE (Cont.)	ExxxH CM120-B ExxxM72-B ExxxP72-B Titanium Clear Titanium Duo
Energy America	ZLK-xxx
Es Foundry	ES-DN8-H54B-xxx ES-DN8-H72-xxx ES-DP8-H54B-xxx ES-DP8-H72-xxx
ET Solar	ET AC Module ET-M772BHxxxTW/TB ET-M772BHxxxWW/WB ET Module ET-N772TBHxxxGL
Fellow Energy	FE72-18X(ND)
First Solar	FS-6XXX(A) FS-6XXX(A)-P FS-6XXX(A)-P-I
Flextronics	FXS-xxxBB
Freedom Forever	FF-MP-BBB-xxx FF-MP1-BBB-xxx
FreeVolt	PVGraf
GCL	GCL-P6 & GCL-M6 Series
Gstar Solar	GSD7S54T-xxxBT GSP7G54M(H)
Hansol	TD-AN3, TD-AN4

Manufacture	Module Model / Series
Hansol (Cont.)	UB-AN1, UD-AN1
Hanwha SolarOne	HSL 60
Heliene	132HC M10 SL Monofacial 144HC M10 NTYP SL Bifacial Module 144HC M10 SL Bifacial 144HC M6 156HC M10 SL Bifacial 36M, 36P 60M, 60P, 72M & 72P Series
HT-SAAE	HT60-156M(V)-C HT60-156M-C HT72-156(M/P) HT72-156M(PD)-BF HT72-156M(PDV)-BF HT72-156P(V)-C HT72-156P-C HT72-166M HT72-18X HT72-18X(ND)-F
Hyperion Solar	HY-DH108N8B HY-DH108P8(B) HY-DH144P8 HY-DH156N8 HY-DH156P8
Hyundai	HiA-SxxxHG HiD-SxxxRG(BK) HiN-SxxxXG(BK) HiN-TxxxNF(BK) HiN-TxxxNI HiN-TxxxNJ HiN-TxxxOJ HiS-SxxxOJ

Manufacture	Module Model / Series
Hyundai(Cont.)	HiS-SxxxXG(BK) HiS-SxxxYH(BK) HiS-SxxxYH(BK) HIS-TxxxNF(BK) HiS-TxxxNJ KG, MG, RW, TG, RI, RG, TI, KI, HI Series
Illuminate USA	IL8-66HGD-xxx M IL5-72HBD-xxx M
Imperial Star	ISM7-SHDD108-400/M
INDEPWR Solar	iPWR-M10-54BX2S-xxxW iPWR-M10-60BX2S-xxxW
Inxeption	mSolar 108BB HC Series (TXI10-xxx108BB) mSolar 144BB HC Series (TXS6-xxx144BB)
ITEK	iT-SE Series
Japan Solar	JPS-60 & JPS-72 Series
JA Solar	** = Backsheet, ## Cell technology i. ##: 01, 02, 03, 09, 10 ii. **: SC, PR, BP, HiT, IB, MW, MR JAM54D41-xxx/MB JAM54S30 xxx/MR JAM54S31 xxx/MR JAM6(K)-60/xxx JAM6(k)-60-xxx/**, JAM60S##-xxx/** JAM6(k)-72-xxx/**, JAM72S##-xxx/** JAM66D45 LB JAM72D10 xxx/MB JAM72D30 xxx/MB JAM72D40 xxx/MB JAM72S30 /MR

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Electrical Bonding and Grounding Test Modules

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Manufacture	Module Model / Series
JA Solar(Cont.)	JAM78D10 xxx/MB JAP6(k)-60-xxx/4BB, JAP60S##-xxx/** JAP6(k)-72-xxx/4BB JAP6 60-xxx JAP72S##-xxx/**
Jinko Solar	JKM & JKMS Series JKMxxxM-6RL3-B JKMxxxM-72HBL-V JKMxxxM-72HL4-(T)V JKMxxxM-72HL4-TV JKMxxxM-72HLM-TV JKMxxxM-72HL-V JKMxxxM-7RL3-TV JKMxxxM-7RL3-V JKMxxxN-54HL4-B JKMxxxN-72HL4-BDV (30mm & 35mm Frame Height) JKMxxxN-72HL4-BDX JKMxxxN-72HL4-TV
Kyocera	KD-F & KU Series
LA Solar	BLA Model LSxxxBF LSxxxBL LSxxxBL (410 watt) LSxxxHC LSxxxHC(166) LSxxxHC (430-450 watt range)
LG Electronics	LGxxx(A1C/M1C/M1K/N1C/N1K/Q1C/Q1K/QAC/QAK)-A6 LGxxx(E1C/E1K/N1C/N1K/N2T/N2W/S1C/S2W/Q1C/Q1K)-A5

Manufacture	Module Model / Series
LG Electronics (Cont.)	LGxxx(M1C/N1C/Q1C/Q1K)-N5 LGxxx(N1C/N1K/N2T/N2W)-E6 LGxxx(N1C/N1K/N2W/Q1C/Q1K)-V5 LGxxx(N1C/N1K/N2W/S1C/S2W)-G4 LGxxx(N1K/N1W/N2T/N2W)-L5 LGxxxN1K-B6 LGxxxN2T-B5 LGxxxN2T-J5 LGxxxN2W-B3 LGxxxN3K-V6
LONGi	LR4-60(HPB/HPH) LR4-72(HBD/HPH) LR4-72HBD xxxM LR5-54HABB-xxx M (fire type 29 only) LR5-54HABB-xxx M (fire type 38 only) LR5-54HPB-xxx M LR5-54HTB xxxM LR5-72HBD xxx M LR6-60 LR6-60(BK/HPB/HPH/HV/PB/PE/PH) LR6-72 LR6-72(BK/HBD/HV/PB/PE/PH) LR7-54HGBB-xxx M LR7-72HGD-xxx M LR8-54HGBB LR8-66HGD-xxx M RealBlack LR4-60HPB RealBlack LR6-60HPB
Maxeon	SPR-MAX3-xxx-BLK-R SPR-MAX3-xxx-COM SPR-MAX3-XXX-R

Manufacture	Module Model / Series
Maxeon (Cont.)	SPR-MAX6-xxx SPR-MAX6-xxx-BLK
Meyer Burger	Meyer Burger Black Meyer Burger Glass Meyer Burger White
Mission Solar Energy	MSE Mono, MSE Perc MSExxx(SR8T/SR8K/SR9S/SX5T) MSExxx(SX5K/SX6W) MSExxxHT0B MSExxxSX5K MSExxxSX5T MSExxxSX6Z MSExxxSX9R MSExxxSX9Z MSH10-xxxHN4G MSH10-xxxHN4G-DC11 MSH10-xxxHT4T MSI10-xxxHN4G MSI10-xxxHT4G MSI10-xxxHT4T MSN10xxxHT4T MSX10-xxxHN0B
Mitrex	Mxxx-L3H, Mxxx-I3H
Mitsubishi	MJE & MLE Series
mSolar	TXI10-xxx108BB
Neo Solar Power Co.	D6M Series
NE Solar	NESE xxx-60MH-M6 NESE xxx 66MHB-G12 NESE xxx-66THB-G12R

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Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the GROUND FIXED TILT system.

Manufacture	Module Model / Series
NE Solar (Cont.)	NESE xxx-72MHB-M10 NESE xxx 72MHB-M10 NESE xxx 72MHT-M10 NESE xxx 72THB-M10
Optivolt	OPT10MxxxB
Panasonic	VBHNxxxSA06/SA06B/SA11/SA11B VBHNxxxSA15/SA15B/SA16/SA16B, VBHNxxxKA, VBHNxxxKA03/04, VBHNxxxSA17/SA17G/SA17E/SA18/SA18E, VBHNxxxZA01/ZA02/ZA03/VBHNxxxZA04, EVPVxxx, EVPVxxx(H/K/PK/HK/HK2)
Peimar	SGxxxM (FB/BF), SMxxxM
Philadelphia Solar	PS-M108(HCBF)-400W (30 & 35mm frames) PS-M144(HCBF)-xxxW PS-MNB108(HCBF)-xxxW PS-MNB144(HCBF)-xxxW
Phono Solar	PSxxxM1-20/U, PSxxxM1H-20/U PSxxxM1-20UH, PSxxxM1H-20UH PSxxxM1-20/UH, PSxxxM1H-20/UH PSxxxM-24/T, PSxxxMH-24/T PSxxxM-24/TH, PSxxxMH-24/TH PSxxxM4(H)-24/TH PSxxxM8GFH-24TNH
Prism Solar	P72 Series, P72X-xxx
Q Cells	Peak G5(SC) , G6(+)(SC)(AC), G7, G8(+) Peak L-G5, L-G6, L-G7, L-G8(BFF) Plus, Pro, Peak, G3, G4, Plus, Pro, Peak L-G2, L-G4, L-G5 Q.PEAK DUO (BLK)-G7

Manufacture	Module Model / Series
Q Cells (Cont.)	Q.PEAK DUO (BLK) G8(+) Q.PEAK DUO (BLK) ML-G10(a)(+) Q.PEAK DUO (BLK) ML-G9(+) Q.PEAK DUO BLK G10(+) Q.PEAK DUO BLK G10+ /AC Q.PEAK DUO BLK-G6+/TS Q.PEAK DUO BLK ML-G10.B+ Q.PEAK DUO BLK ML-G10.C+ Q.PEAK DUO BLK ML-G10.a+ Q.PEAK DUO BLK ML-G10+ / t Q.PEAK DUO BLK ML-G10+ / TS Q.PEAK DUO G10+ Q.PEAK DUO XL-G11S.3 / BFG Q.PEAK DUO XL-G9.3 BFG Q.PEAK DUO(BLK)-G6+ Q.TRON BLK M-G2+ Q.TRON BLK M-G2(.H1)(.F1)(.C1)+/AC Q.TRON BLK M-G2+ AC Q.TRON BLK M-G2.C+ Q.TRON BLK M-G2.F+ Q.TRON BLK M-G2.F1+/AC Q.TRON BLK M-G2.H+ Q.TRON BLK M-G2.H1+/AC Q.TRON BLK M-G2+ SERIES Q.TRON M-G2+ SERIES Q.TRON ML-G3.3/BFG Q.TRON XL-G2.3 / BFG (where “X” = any letter between A to W, where “Y” = any number between 1 to 9.) QPEAK DUO G10.C1+ AC Q.PEAK DUO L-(G7/G7.1/G7.2/G7.3/G7.7) Q.PEAK DUO BLK ML-G10+/AC Q.PEAK DUO BLK ML-G10.C1+/AC

Manufacture	Module Model / Series
Q Cells (Cont.)	Q.PEAK DUO BLK ML-G10.D+ Q.PEAK DUO BLK ML-G10.D1+/AC Q.PEAK DUO BLK ML-G10.XY+/AC Q.PEAK DUO L-(G8/G8.1/G8.2/G8.3) Q.PEAK DUO L-G6.3 / BFG Q.PEAK DUO L-G8.3 BFG/BGT Q.PEAK DUO ML-G12S.3 / BFG Q.PEAK DUO ML-G12S.3/BFG Q.PEAK DUO ML-G12S.7/BFG Q.PEAK DUO ML-G12S.d / BFG Q.PEAK DUO ML-G12S.P3 / BFG Q.PEAK DUO XL-(G10/G10.2/G10.3/G10.c/G10.d) Q.PEAK DUO XL-(G11.2/G11.3) Q.PEAK DUO XL-(G9/G9.2/G9.3) Q.PEAK DUO XL-G10.3/BFG Q.PEAK DUO XL-G10.d/BFG Q.PEAK DUO XL-G11.3/BFG Q.PEAK DUO XL-G11S.B3 / BFG Q.PEAK DUO XL-G11S.L3 / BFG Q.TRON BLK M-G2+/AC Q.TRON BLK M-G2.C1+/AC Q.TRON BLK M-G2.C3+/AC Q.TRON BLK M-G2.C4+/AC Q.TRON BLK M-G2.D+ Q.TRON BLK M-G2.D1+/AC Q.TRON BLK M-G2.D2+/AC Q.TRON BLK M-G2.Y+

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Electrical Bonding and Grounding Test Modules

The list below is not exhaustive of compliant modules but shows those that have been evaluated and found to be electrically compatible with the GROUND FIXED TILT system.

Manufacture	Module Model / Series
REC	RECxxxAA (BLK/Pure/Pure-R/ Pure-RX/ Pure 2/ Pro M) RECxxxAA Pure-RX RECxxxAA PURE-RX-DC RECxxxNP (N-PEAK) RECxxxNP2 (Black) RECxxxNP3 Black RECxxxPE, RECxxxPE72 RECxxxTP, RECxxxTP72 RECxxxTP2(M/BLK2) RECxxxTP2S(M)72 RECxxxTP3M (Black) RECxxxTP4 (Black)
Regitec Solar	RMHT54/xxxAB2
Renesola	All 60-cell modules RS6-xxxNBG-E3
Risen	RSM Series, RSM110-8-xxxBMDG
Runergy	HY-DH132N11 HY-DH96N11B
SEG Solar	SEG-xxx-BMD-HV, SEG-xxx-BMD-TB SEG-XXX-BMB-TB, SEG-xxx-BMA-HV SEG-xxx-BMA-TB, SEG-xxx-BMB-HV SEG-xxx-BMA-BG, SEG-xxx-BMB-BG SEG-xxx-BTA-BG, SEG-xxx-BTB-BG SEG-xxx-BMD-BG, SEG-xxx-BTD-BG
S-Energy	SL40-60MAI/MBI/MCI-xxxV SL45-60BGI/BHI SL45-60MBI-xxxZ SN72 & SN60 Series

Manufacture	Module Model / Series
Seraphim	SEG-(6PA/6PB/6MA/6MA-HV/6MB/E01/ E11) SRP-(6QA/6QB) SRP-320-375-BMB-HV SRP-390-405-BMD-HV SRP-390-450-BMA-HV SRP-xxx-6MB-HV SRP-xxx-BMC-HV SRP-xxx-BMD-HV SRP-xxx-BMZ-HV SRP-xxx-BTA-BG SRP-xxx-BTB-BG SRP-xxx-BTC-BG SRP-xxx-BTD-BG SRP-xxx-BTE-BG
Sharp	NU-SA & NU-SC Series
Silfab	SLA-M, SLA-P, SLG-M, SLG-P & BC Series SILxxx(BG/BK/BL/HC/HC+/HL/HM/HN/ML/ NL/NT/NX/NU/ QD/QM) SIL-xxx XM SIL-xxx XM+
Sirius PV	ELNSM54M-HC-BF Series ELNSM54M-HC-N ELNSM54M-HC Series ELNSM72M-HC Series

Manufacture	Module Model / Series
Solar4America	S4Axxx-108MH10BB S4Axxx-108MH10xxx S4Axxx-108TH10xxx S4Axxx-144MH10xxx S4Axxx-144TH10xxx S4Axxx-144TH16xxx S4Axxx-72MH5BB
SolarEver USA	SE-166*83-xxxM-120N SE-182*105-xxxM-96-BD SE-182*91-xxxM-108N
Solaria	PowerXT-xxxR-(AC/PD/BD) PowerXT-xxxC-PD PowerXT-xxxR-PM (AC) PowerX-400R
Solar Space	SS8-54HDB-xxx-N SS8-54HD-xxx-N SS8-72HD-xxx-M SS8-72HD-xxx-N SS9-66HD-xxx-N SSA-48HDB-xxx-N SSA-48HD-xxx-N SSA-54HDB-xxx-N SSA-54HD-xxx-N SSA-66HD-xxx-N
Solartech	STU HJT, STU PERC & Quantum PERC
SolarWorld	Sunmodule Protect, Sunmodule Plus/Pro
Sonali	SS-M-360 to 390 Series SS-M-390 to 400 Series SS-M-440 to 460 Series SS-M-430 to 460 BiFacial Series
Sun Edison	F-Series, R-Series

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Electrical Bonding and Grounding Test Modules

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Manufacture	Module Model / Series
SunGold Power	SG415WM
Suniva	MV Series & Optimus Series (35mm)
Sunket Solar	SKT580M10-144S2
Sunmac Solar	M754SH-BB Series
SunPlus Optimum	SR4-54HTB-xxxM
SunPower	AC, X-Series, E-Series & P-Series SPR E20 435 COM (G4 Frame) Axxx-BLK-G-AC, SPR-Mxxx-H-AC SPR-Mxxx-H-AC, SPR-Mxxx-BLK-H-AC
SunPro	SPDGxxx-120M12 SPDGxxx-N108M10 SPDGxxx-N144M10
Suntech	STP, STPXXXS - B60/Wnhb
Talesun	TP572, TP596, TP654, TP660 TP672, TP6L72M-450 ,Hipor M, Smart TD6I72M TD7G72M TM3G48M TM3G54M TM3G66M TM7G54M TM7G60M TM7G72M TP6F72M TP6F72M(H) TP7G54M(H)
Tata Power Solar	TPxxxHG10B

Manufacture	Module Model / Series
Tesla	SC, SC B, SC B1, SC B2, TxxxS, TxxxH Tesla Solar Panel TSP-415/TSP-420
Thornova	TS-BBT54(xxx) TS-BG54 TS-BG72 TS-BGT72(xxx)
TP Solar	TPxxxVG12R16NB
Trina	DE09.05, DE09C.07 DEG15HC.20(II), DEG15MC.20(II) DEG15VC.20(II), DE18M(II), DEG18MC.20(II) DE19, DEG19C.20 PA05, PD05, DD05, DD06, DE06, PD14, PE14, DD14, DE14, DE15, DE15V(II) TSM-DE06X.05(II) TSM-DE09.05 TSM-DE09.08 TSM-DE09C.07 TSM-DE15H(II) TSM-DEG21C.20 TSM-NE09RC.05 TSM-NE09RH.05 TSM-NE19RC TSM-NED19RC.20 TSM-NEG19RC.20 TSM-NEG21C.20 TSM-NEG9RH.25
TSMC	TS-150C2 CIGSw

Manufacture	Module Model / Series
Universal Solar	UNI4xx-144BMH-DG UNI5xx-144BMH-DG UNIxxx-108M-BB UNIxxx-120M-BB UNIxxx-120MH
Upsolar	UP-MxxxP, UP-MxxxM(-B)
URECO	D7Kxxx(H7A/H8A), D7Mxxx(H7A/H8A) F6MxxxE7G-BB FAKxxx(C8G/E8G) FAMxxxE7G-BB FAMxxxE8G(-BB) FBKxxxM8G FBMxxxM7G-BB FBMxxxMFG-BB
Vikram Solar	Eldora, Somera, Ultima PREXOS VSMDHT.60.AAA.05 PREXOS VSMDHT.72.AAA.05 Paradea VSMDH.72.AAA.05
Vina	VNS-72M1-5-xxxW-1.5 VNS-72M3-5-xxxW-1.5 VNS-144M1-5-xxxW-1.5 VNS-144M3-5-xxxW-1.5 VNS-120M3-5-xxxW-1.0

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Electrical Bonding and Grounding Test Modules

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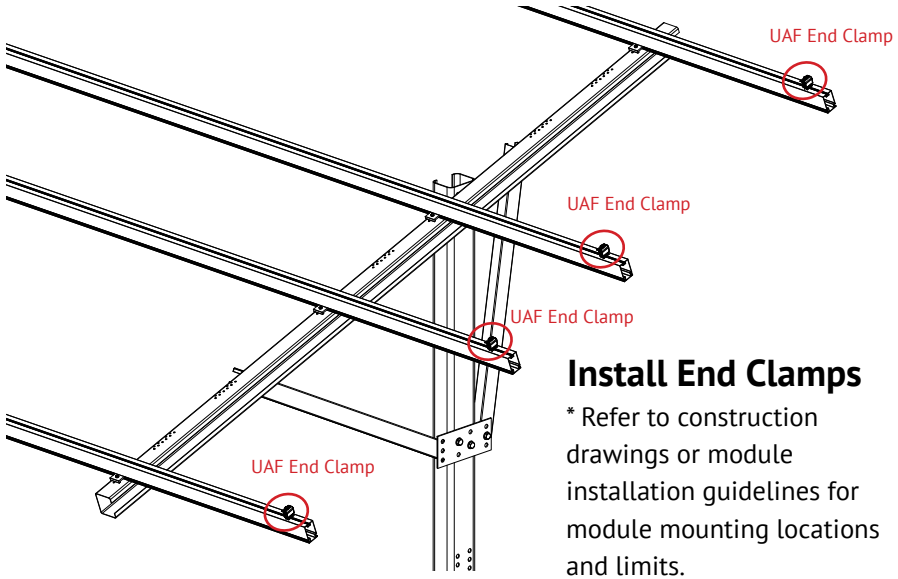
Manufacture	Module Model / Series
VSUN	VSUN4xx-144BMH VSUN4xx-144BMH-DG VSUN5xx-144BMH-DG VSUNxxx-108BMH VSUNxxx-108M-BB VSUNxxx-108MH VSUNxxx-120BMH VSUNxxx-120M-BB VSUNxxx-132BMH VSUNxxx-144M-BB VSUNxxx-60M-BB VSUNxxx-72MH VSUNxxxN-108BMH-BB VSUNxxxN-108BMH-BB (SoftPaw) VSUNxxxN-108BMH-DG-BB VSUNxxxN-120BMH-BB (SoftPaw) VSUNxxxN-132BMHR VSUNxxxN-144BMH VSUNxxxN-144MH VSUNxxx-144BMH VSUNxxx-144MH VSUNxxx-144M-BW VSUNxxxN-144BMH-DG
Waaree	Ahnay Series Bi-33 Arka Series WSMDi Bi-55-xxx BiN-08-xxx
Winaico	WST & WSP Series
Yingli	YGE & YLM Series
Yotta Energy	YSM-B450-1

Manufacture	Module Model / Series
ZNShine Solar	ZXM6-72 Series ZXM6-NH120 Series ZXM6-NH144 ZXM6-NHLDD144 ZXM7-SH108 Series ZXM7-SHDB144 ZXM7-SHLDD144 ZXM7-UHLDD108 ZXM7-UHLDD144 ZXM8-GPLDD132 Series ZXM8-TPLDD132

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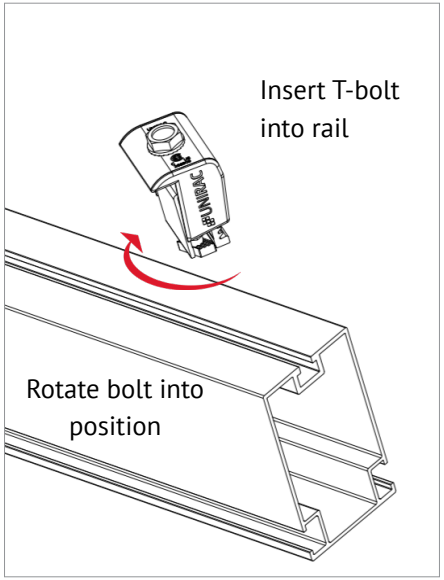
- The frame profile must not have any feature that might interfere with the bonding devices that are integrated into the racking system
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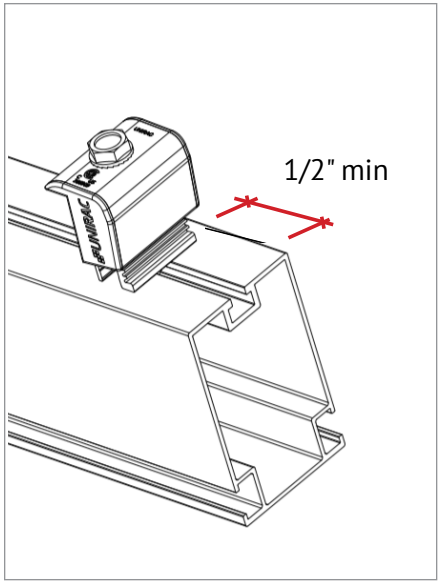
UNIVERSAL AF CLAMPS INSTALL MODULE W/END CLAMPS



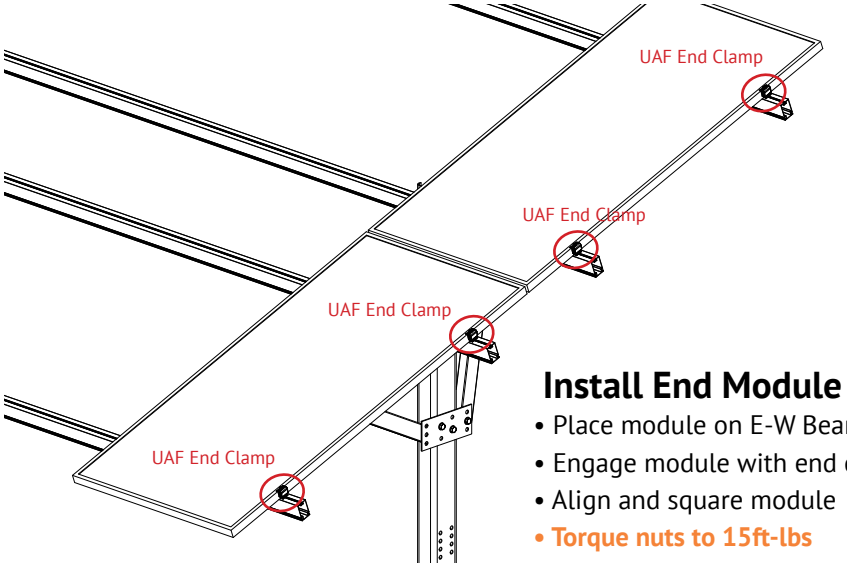
Install End Clamps

* Refer to construction drawings or module installation guidelines for module mounting locations and limits.





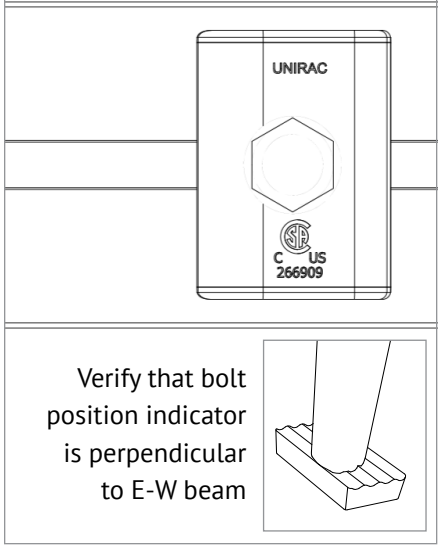
NOTE - Universal AF End Clamps are single use only

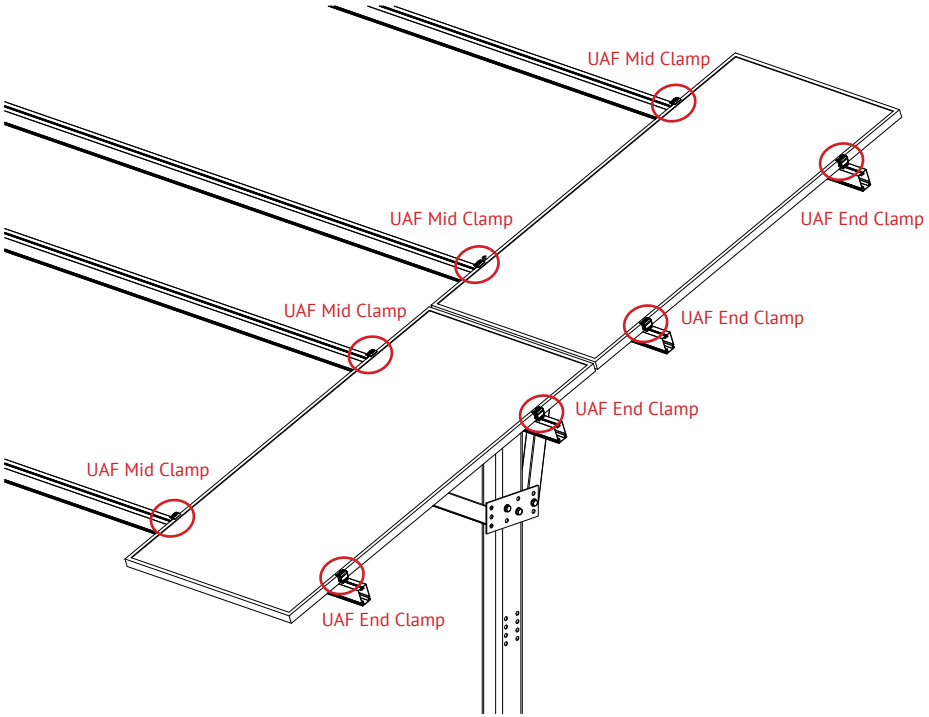


Install End Module

- Place module on E-W Beams
- Engage module with end clamps
- Align and square module
- **Torque nuts to 15ft-lbs**

Serrated T- Bolts

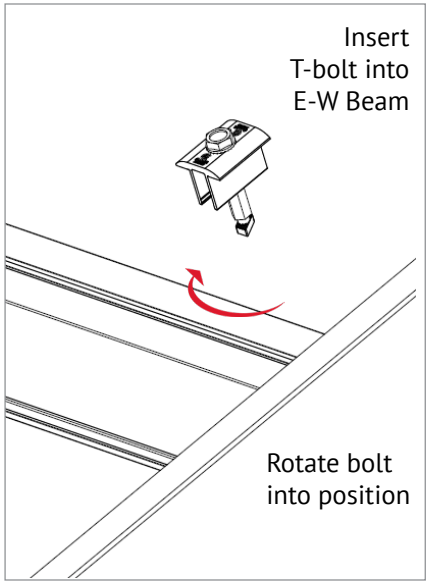


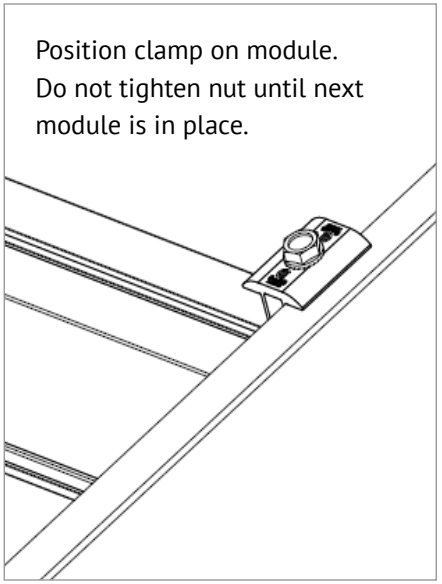


Install Mid Clamps

(Position upright against module but do not torque.) When ready - **torque to 15ft-lbs.**

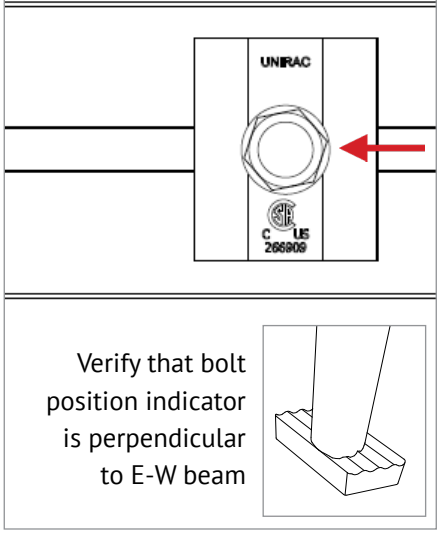
NOTE: Please refer to the GFT Shared rail install manual when using a shared rail.

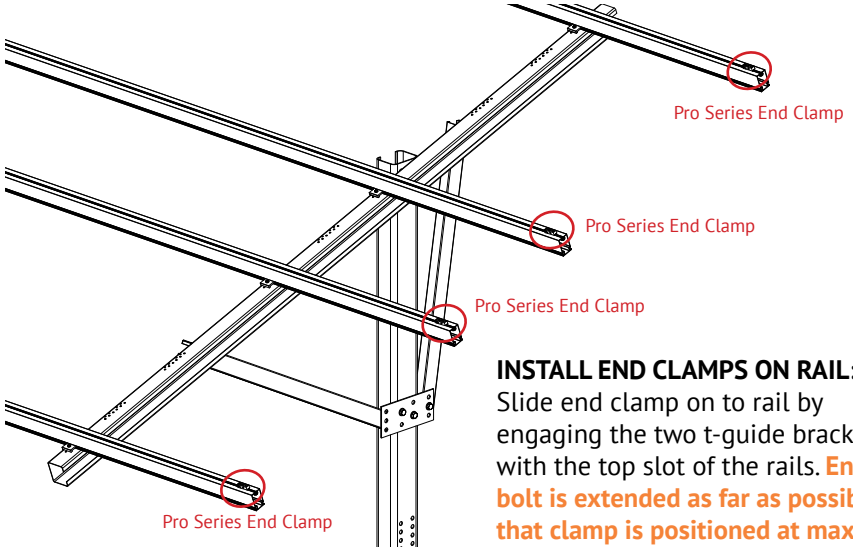




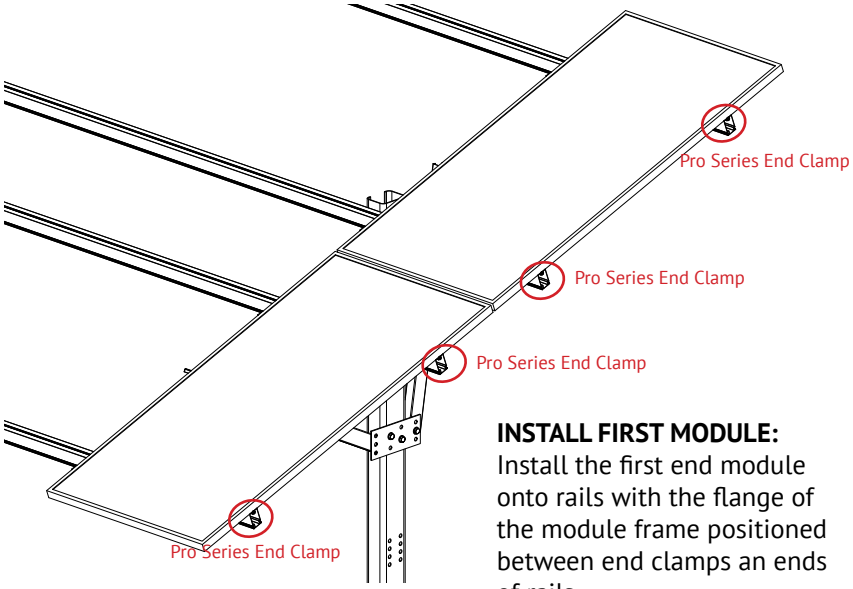
NOTE - Universal AF Mid Clamps are single use only

Serrated T- Bolts

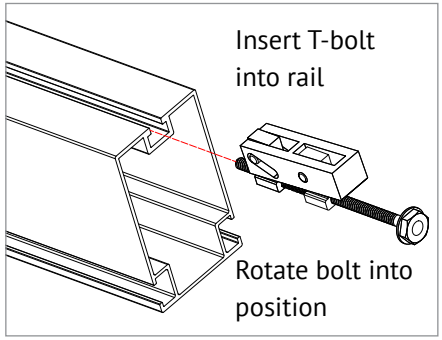




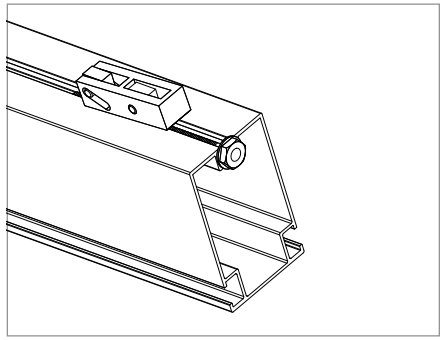
INSTALL END CLAMPS ON RAIL:
Slide end clamp on to rail by engaging the two t-guide brackets with the top slot of the rails. **Ensure bolt is extended as far as possible so that clamp is positioned at max. distance from end of rail.**



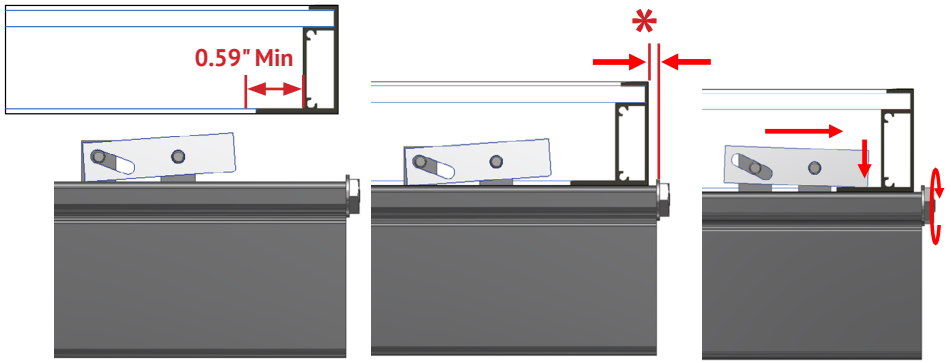
INSTALL FIRST MODULE:
Install the first end module onto rails with the flange of the module frame positioned between end clamps an ends of rails.



POSITION END CLAMPS:
Slide end clamp assembly on to rail until bolt head engages with end of rail. End clamps are positioned on rails prior to the first end module and prior to the last end module.



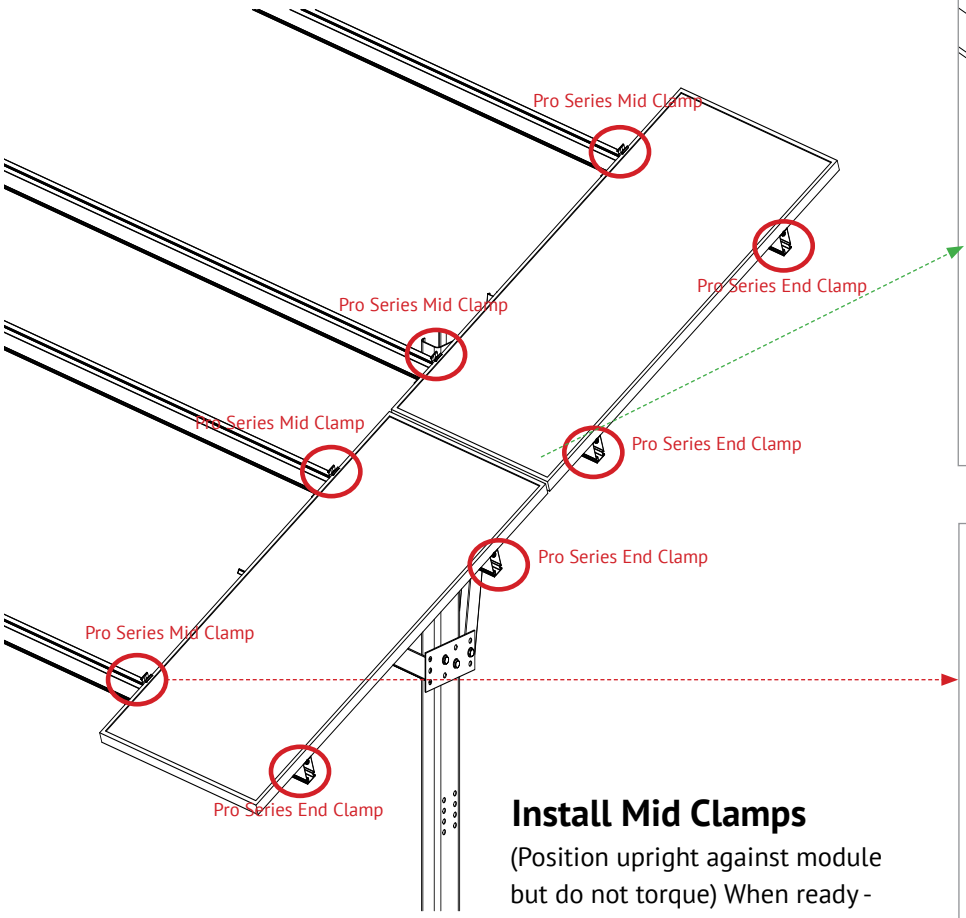
NOTE - To assist insertion of clamp into rail slot, Pressure may be applied to top or side of bracket as shown. Do not force clamp into rail by pushing on bolt with excessive force.



ENGAGE CLAMP:
While holding module in position and with flange in full contact with rail, rotate end clamp bolt until clamp engages with flange to provide clamp force. **To ensure bolt is not over-torqued, use low torque setting on drill or If using an impact driver, stop rotation as soon as impact action of driver begins.** **Torque End clamp bolt to 5 ft-lbs, No anti-seize**

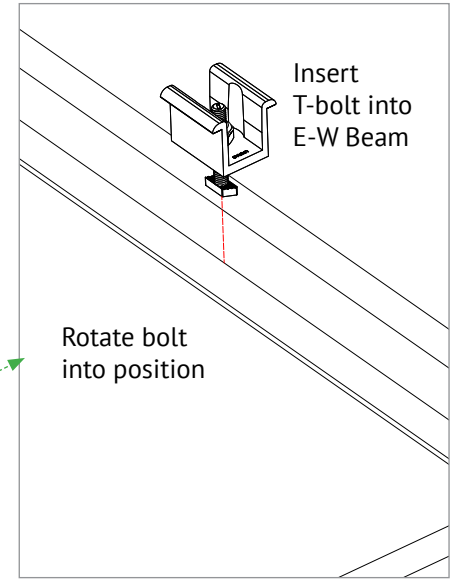
* Position module flush with ends of rails. Rails should not extend more than 1/2" beyond module. Module must be fully supported by rails and cannot overhang ends of rails.

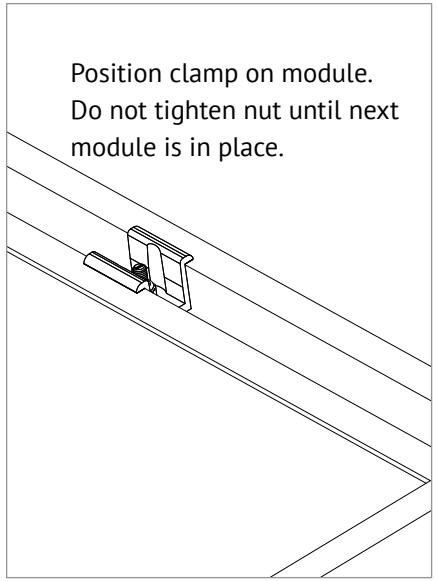
NOTE:
Requires minimum return flange length of 0.59" for Pro Series Hidden Endclamp to secure module



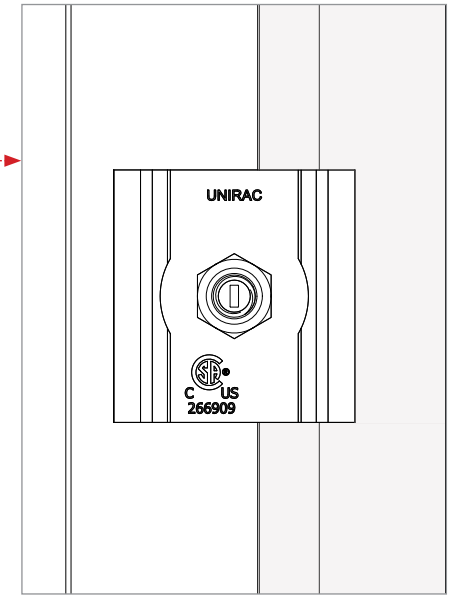
Install Mid Clamps

(Position upright against module but do not torque) When ready - **torque to 11ft-lbs.**

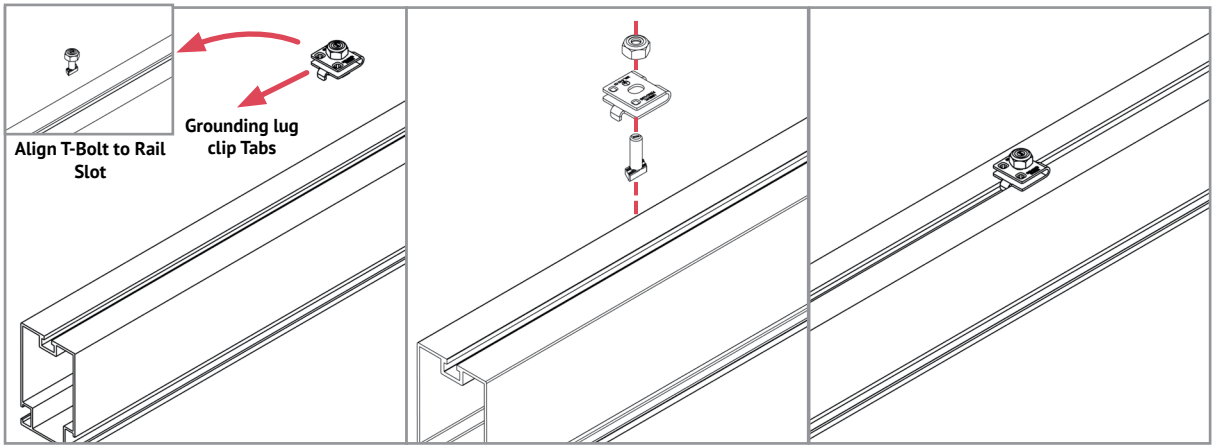




Note - Pro Series Mid Clamps are single use only

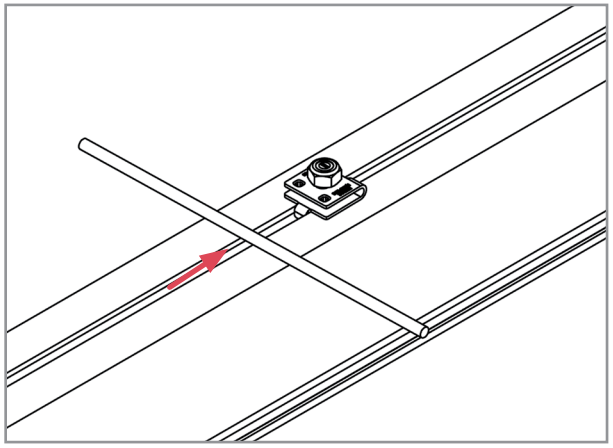


Verify that bolt position indicator is perpendicular to E-W beam once nut is torqued



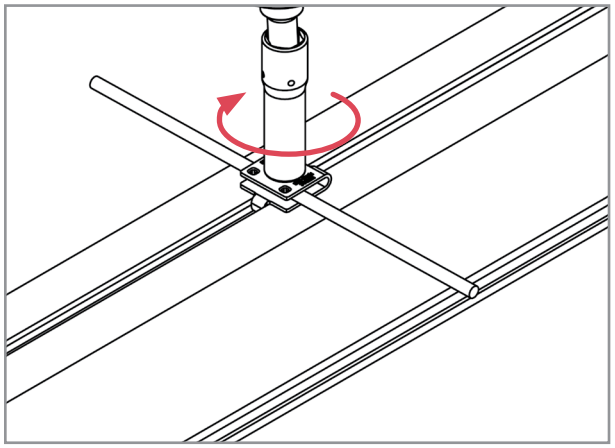
STEP 1: POSITION THE GROUNDING LUG

- Place the Grounding Lug on the rail with pre-assembled 1/4" T-bolt and nut.
- Ensure the Grounding Lug Clip tabs are positioned inside the rail.



STEP 2: INSERT GROUNDING WIRE

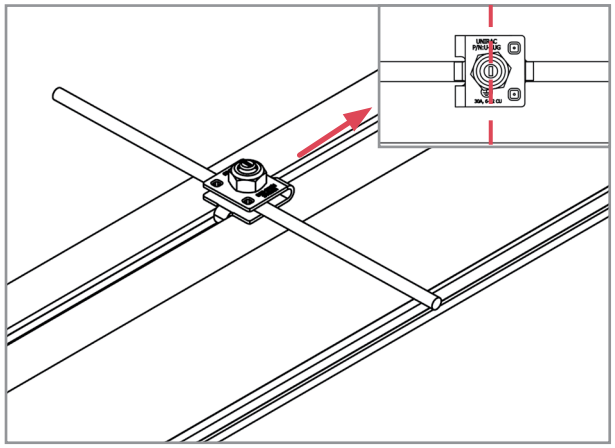
- Insert the copper grounding wire (6-12 AWG) into the Grounding Lug Clip.



STEP 3: SECURE GROUNDING LUG TO RAIL

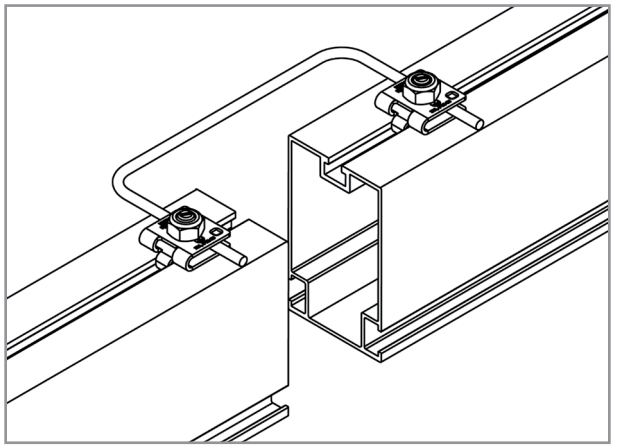
- Tighten the 1/4" nut to secure the Grounding Lug to Rail.

Torque the 1/4" nut to 10 ft-lbs.
NOTE: The Grounding Lug is single use only.



ALIGN POSITION INDICATOR

- Verify that the position indicator on the bolt is perpendicular to the rail.



TO ESTABLISH EAST-WEST BONDING

- Place a Grounding Lug at one end of the rail, closer to the adjacent rail end
- Insert the grounding wire into the Grounding Lug and tighten the 1/4" nut to secure both the Grounding Lug and the wire to the rail

Torque the 1/4" nut to 10 ft-lbs.