

SnapNrack™ Roof Mount



The Only Wholesale
Distributor You'll Ever Need

2009

Code Compliant Installation Manual

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Table of Contents

1. INTRODUCTION.....	1
1.1 OVERVIEW OF THE SNAPNRACK SYSTEM.....	1
1.2 OVERVIEW OF THIS MANUAL.....	2
1.3 YOUR RESPONSIBILITY AS INSTALLER.....	2
1.4 SUPPORT	3
2. PREPARE FOR THE INSTALLATION.....	4
2.1 IDENTIFY TYPE OF ROOF.....	4
2.2 IDENTIFY SNAPNRACK COMPONENTS.....	4
2.3 OBTAIN INSTALLER SUPPLIED TOOLS AND MATERIALS.....	6
2.4 SURVEY THE SITE	6
2.5 LAY OUT SYSTEM ON THE ROOF	7
3. FLUSH MOUNT ON COMPOSITION ROOFS (USING L-FEET)	10
3.1 INTRODUCTION	10
3.2 LOCATE ATTACHMENT POINTS	10
3.3 DRILL PILOT HOLES	11
3.4 SECURE BASE	12
3.5 INSTALL FLASHING	13
3.6 ATTACH L-FOOT	13
4. FLUSH MOUNT ON OTHER ROOF TYPES (USING STANDOFFS)	14
4.1 INTRODUCTION	14
4.2 DETERMINE TYPE AND SIZE OF ATTACHMENT AND FLASHING.....	15
4.3 LOCATE ATTACHMENT POINTS	16
4.4 MARK ATTACHMENT POINTS	16
4.5 DRILL PILOT HOLES	17
4.6 SECURE THE BASE	17
4.7 ATTACH STANDOFF AND INSTALL FLASHING	19
5. TILT MOUNT (USING STANDOFFS AND EXTENSIONS).....	20
5.1 INTRODUCTION	20
5.2 DETERMINE TYPE OF TILT ASSEMBLY.....	20
5.3 SHALLOW TILT KITS.....	21
5.4 FULL TILT KITS.....	22
5.5 INSTALLING ON L-FEET.....	23

6. INSTALL RAILS	24
6.1 SNAP IN CHANNEL NUTS	24
7. INSTALL RAIL SPLICES	25
7.1 SNAP IN SPLICE INSERT	25
8. LEVEL RAILS.....	26
8.1 OVERVIEW	26
8.2 ADDITIONAL LEVELING FOR L-FOOT MOUNTED RAILS	26
8.3 ADDITIONAL LEVELING FOR STANDOFF MOUNTED RAILS.....	27
9. INSTALL MODULES ON RAILS	29
9.1 PREPARE CLAMPING HARDWARE.....	29
9.2 SET FIRST MODULE	30
9.3 CONNECT WIRING	31
9.4 CONNECT GROUNDS	31
9.5 TRIM RAILS.....	31
10. FINAL CHECK.....	32
10.1 CHECK SECURITY OF MODULES	32
10.2 CHECK TIGHTNESS OF ALL BOLTS	32
10.3 CHECK WIRES AND GROUNDS	32
11. APPENDIX.....	33
11.1 ENGINEERING CERTIFICATION LETTER.....	33
11.2 RAIL SPAN TABLES.....	35
11.3 SNAPNRACK WARRANTY	37

1. Introduction

1.1 Overview of the SnapNrack System

AEE Solar offers a low profile, visually appealing, photovoltaic (PV) module installation system called SnapNrack. This innovative system simplifies the process of installing solar PV modules, shortens install times, and lowers installation costs.

SnapNrack systems, when installed in accordance with this manual, will be structurally



adequate for the specific installation site and will meet the local building code and the Uniform Building Code.

The SnapNrack installation system is a set of engineered components that can be assembled into a wide variety of PV mounting structures. It is designed to be installed by qualified Solar installation technicians. With SnapNrack you will be able to solve virtually any PV module mounting challenge.

1.2 Overview of this Manual

This manual describes the installation procedures for standard roof mounting for AEE Solar photovoltaic (PV) arrays. It guides you through the correct procedures for mounting the AEE Solar SnapNrack PV module racking system on the major types of roof structures and materials. It also provides layout and installation tips and directions.

This manual provides information on installing AEE Solar PV modules on the most common types of residential roof surfaces.

Review this entire manual before installing the SnapNrack system.

Throughout this manual you will see highlighted notes which will provide you with different types of information:



Notices indicate important information to help with the installation or to avoid potential damage to the structure or components.



Cautions indicate a potential for property damage, personal injury, or death.

For questions, contact the AEE Solar technical support department. Find contact information for all AEE Solar branches at www.aeesolar.com.

For information on ground (pipe) mount installation procedures, refer to AEE Solar's SnapNrack Pipe Mount Installation Manual.

1.3 Your responsibility as installer

Comply with all applicable local or national building codes, including any that may supersede this manual.

- Make sure that the SnapNrack components and other products are appropriate for the particular installation and the installation environment.
- Make sure that the roof, its rafters, connections, and other structural members can support the array in compliance with all applicable code requirements.
- Use only AEE Solar supplied parts.

- Make sure that lag screws are properly and securely tightened into roof rafters and that roof members are structurally sound.
- Maintain the waterproof integrity of the roof, including the proper use of roofing sealant and selection of appropriate flashings for post type installations (see section 4.3 for flush-mount installations using standoffs and section 5.4 for tilted installations using standoffs).



Note: L-foot type mounting assembly includes flashing material.

- Ensure safe installation of all electrical aspects of the PV array.



All installers working on any roof surface must always follow necessary and applicable precautions for working in a rooftop environment including maintaining a secure attachment to a regulation fall protection safety harness that conforms to OSHA standards.



If it is raining, or if you anticipate any potentially dangerous conditions, do not proceed with the installation.



All tools and equipment used on the roof should be secured to avoid falling object hazards.



All equipment should be properly maintained and inspected prior to use.



Any exposed studs should be protectively capped to help avoid injury.

1.4 Support

For help with your installation, call the nearest AEE Solar office. You can find contact information for AEE Solar by visiting www.aeesolar.com and clicking on *Contact Us*.

2. Prepare for the installation

2.1 Identify type of roof

Roofs on residential buildings are constructed primarily of three types of material: asphalt shingles (commonly known as composition shingles), tile or slate (which we will refer to as tile), and wood or shake shingles (which we will refer to as shake).

PV array installations on composition roof surfaces using the SnapNrack flashed L-foot components as described in section 3, offers the quickest and easiest SnapNrack installation solution.

Installations on tile or shake roofs, or thicker composition roofs that exceed a typical 1/8 inch material thickness (often called *presidential composition*), should not use SnapNrack L-feet and should instead use standoffs as described in section 4.

Installation of PV arrays tilted at an angle to the roof surface is described in section 5.



Sometimes stainless steel hardware has a tendency to seize up when it is exposed to sunlight and gets hot. To reduce the possibility of seizing, apply lubricant to bolts, shade the hardware prior to installation, and avoid spinning on nuts at high speed.

2.2 Identify SnapNrack components

Make sure you have all the necessary SnapNrack system components — shown below — needed to complete the installation.



Snap-in channel nut



Rails — black or silver



Rail splice assembly — snap-in insert and top piece



L-foot assembly — base, L-foot, stamped steel flashing



Standoff assembly — base and standoff shaft (various lengths)



Leveling spacer — 1 inch



Rain collar



Module mid clamp assembly



Module end clamp assembly

2.3 Obtain installer supplied tools and materials

Make sure you have all the necessary additional hardware components, tools, and other material that are needed to complete the installation.

These include:

- Appropriate roof flashings for standoff installations
- Lag bolts and washers for roof attachments
- Waterproof roofing sealant (such as Rainbuster) in a color to match the color of the roof
- ½ inch box / open end wrench
- 3/8 inch ratchet wrench with ½ inch socket
- 3/8 inch socket adapter bit for drill
- Power drill with 3/16 inch x 6 inch and 12 inch drill bits for lag bolt pilot holes
- 5/32 inch Allen key for leveling spacers on standoffs
- Tools for attaching grounding hardware
- Reciprocating saw (such as a Sawzall or Mitterbox) with correct blade for trimming non-ferrous metal rails
- Metal file for finishing trimmed rails
- Chalk line and grease pens (in two or three different colors) for marking mounting locations on the roof material
- Tape measure
- Flat pry bar
- Structural plans for the building when available

2.4 Survey the site

- Measure the roof surfaces and develop an accurate drawing of the roof and any obstacles such as chimneys and roof vents.
- If plans are available, check to make sure that the plans match the final structure.
- Review the shading pattern across the roof surface from the residence itself, from adjacent structures, and from other nearby features such as trees.
- Identify any roof access areas or keep-out areas as required by the local jurisdiction.
- Confirm roof construction, type, and condition.
- Assess roof rafter size, material, and span to confirm that the structure is sound and can support the additional load of the array.
- Identify any construction anomalies that may complicate the process of locating rafters from the roof surface.
- Measure the spacing between the rafters.
- If you find structural problems such as termite damage or cracked rafters that may compromise the structure's integrity, consult a structural engineer.

Determine the design wind speed and site specific conditions for the site and reference the structural engineering tables (see section 11, Appendix) to determine the maximum allowable rail span for this site.

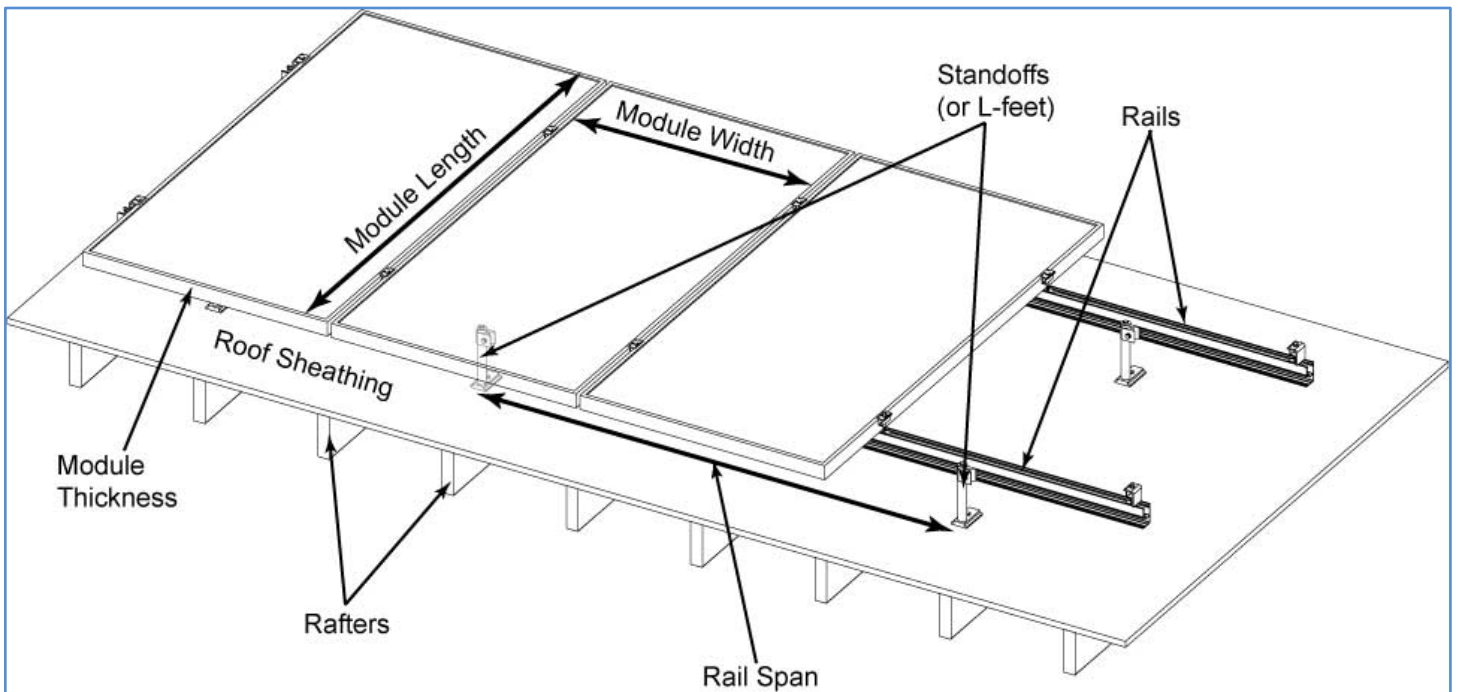
If you are unsure about the local design wind speed, consult with the local building jurisdiction.

2.5 Lay out system on the roof

Using the information collected in the site survey, complete a system layout showing array location and distances from key roof features. Include any information necessary for the permitting process.

The following definitions are used to describe array layout designs:

- Module length—the measurement along the longest side of the module frame
- Module width—the measurement along the shorter side of the module frame
- Module thickness—the measurement of the thickness of the module

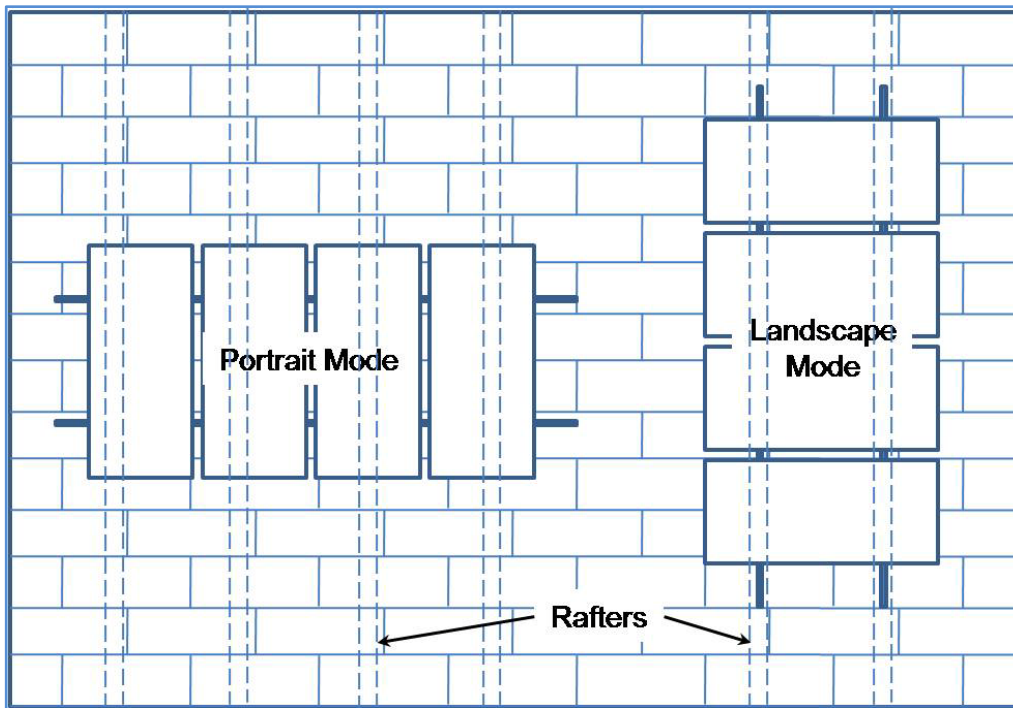


Layout of PV modules showing rail span

Typically, PV modules are installed in *portrait mode*, with the long side of the module running up the roof slope and the rails running horizontally across the roof perpendicular to the roof rafters, which commonly run down slope.

When laying out the array, be sure to leave space for the module clamps on the rails.

Module mid clamps (see photo on page 5) are installed between modules in a row and require $\frac{1}{2}$ inch of space between the modules.



Alignment of PV modules

Arrays can also be installed in *landscape mode*, with the modules oriented so that their long edge runs horizontally across the roof and the rails run up the roof slope.

Landscape mode is typically used in cases where the roof has been constructed with structural elements running horizontally across the roof, but can also be used on standard residential buildings for a variety of reasons including to facilitate a convenient layout.

Module end clamps (see photo on page 5) require $1\frac{1}{2}$ inches of extra rail to extend past the end of the module frame.

The space between rows of modules is not critical, but it is common for rows of modules to be installed so that the modules are flush with each other.

Submit array plans to local permitting jurisdiction and proceed with the roof layout only when all permits for the project have been granted by the authority having jurisdiction.



Caution: If possible leave at least 3 to 4 feet around the outside edges of the array to enable safe access during the installation and during maintenance and cleaning.

Transfer the array layout to the roof using grease pens to mark the inside and outside corners of the array.

Locate estimated rafter positions and mark them in the array area with a different color grease pen.



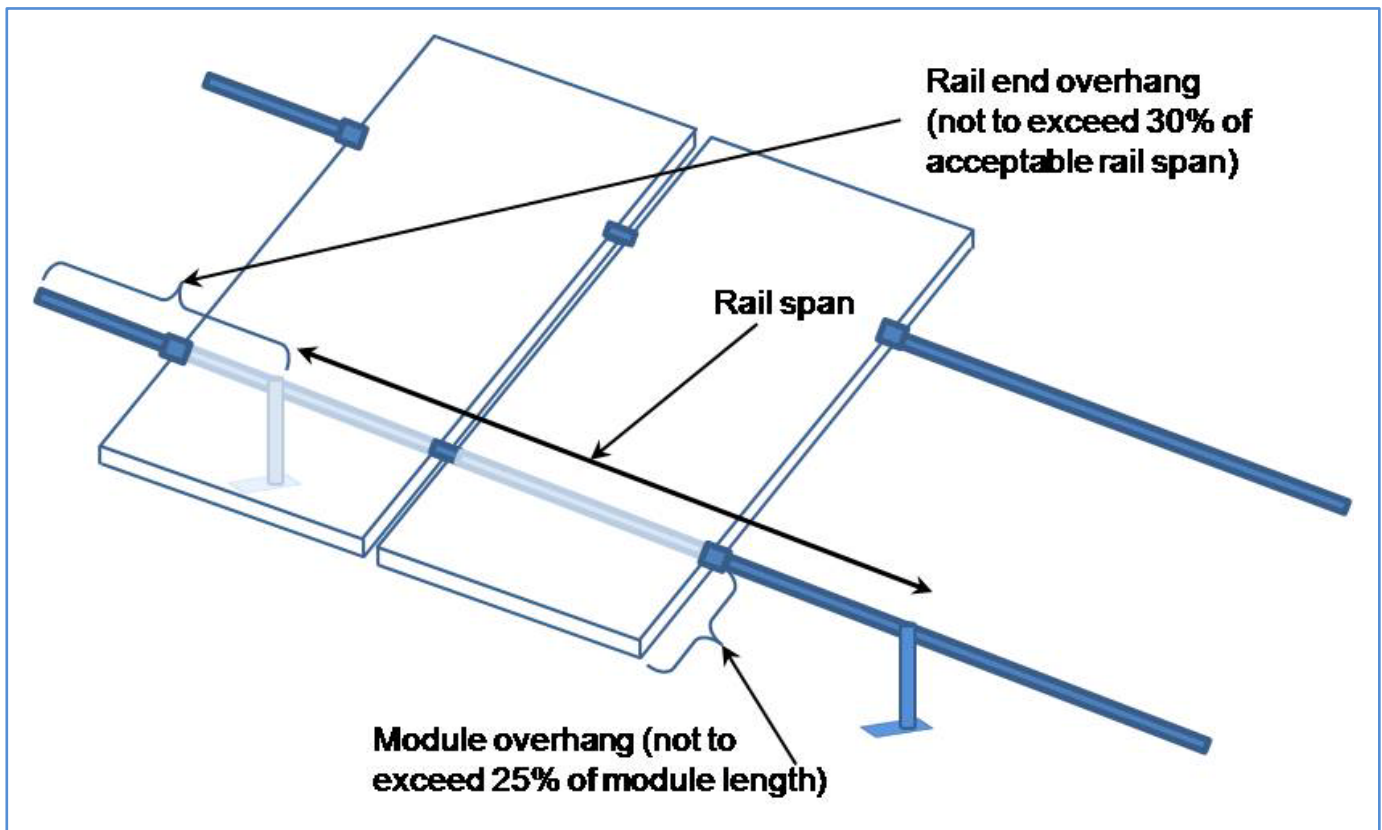
Common techniques for locating rafters include looking under the eaves, measuring from the ends of the roof, using attic access, and using electronic stud and rafter finders.

Transfer rail and estimated standoff locations to the roof, noting that standoffs will be located at intersections of rails and rafters.

Layout rails such that module frame ends do not overhang mounting rails by more than 25% of total module frame length.

Verify that mounting rail spans are in accordance with the rail span tables in the *Appendix* at the back of this manual (section 11).

Verify that rail ends do not overhang by a distance greater than 30% of the acceptable rail span specified in the same table.



Location of rail end overhang and module overhang

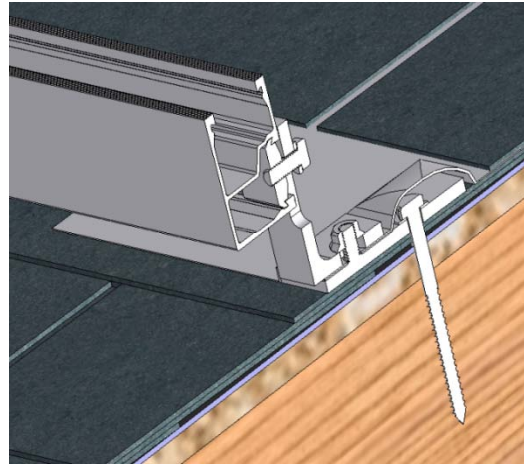
3. Flush mount on composition roofs (using L-feet)

3.1 Introduction

Typically, using flashed L-feet to mount PV modules enables a faster and simpler installation than using standoffs, but the L-foot type of mount can only be used on composition roofs.

Installations on shake and tile roof surfaces, as well as thicker composition roofs (that is, thicker than 1/8 inch), require the use of standoffs and standard flashings.

For installations using standoffs, see section 4.
For installations where the PV modules will be installed tilted at an angle to the roof surface, see section 5.

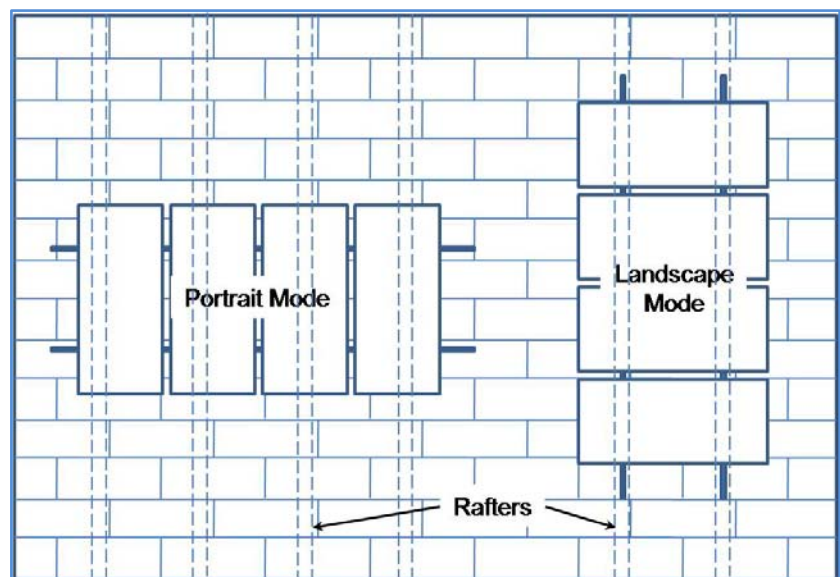


Flashed L-foot section view

3.2 Locate attachment points

The location of the attachment points for L-foot mounts depends on the orientation of the modules relative to the rafters as shown in this diagram.

Using the array layout plans and the estimated rafter locations, determine the location of all attachment points and mark the holes for each L-foot base.



PV module orientation relative to rafters

3.3 Drill pilot holes

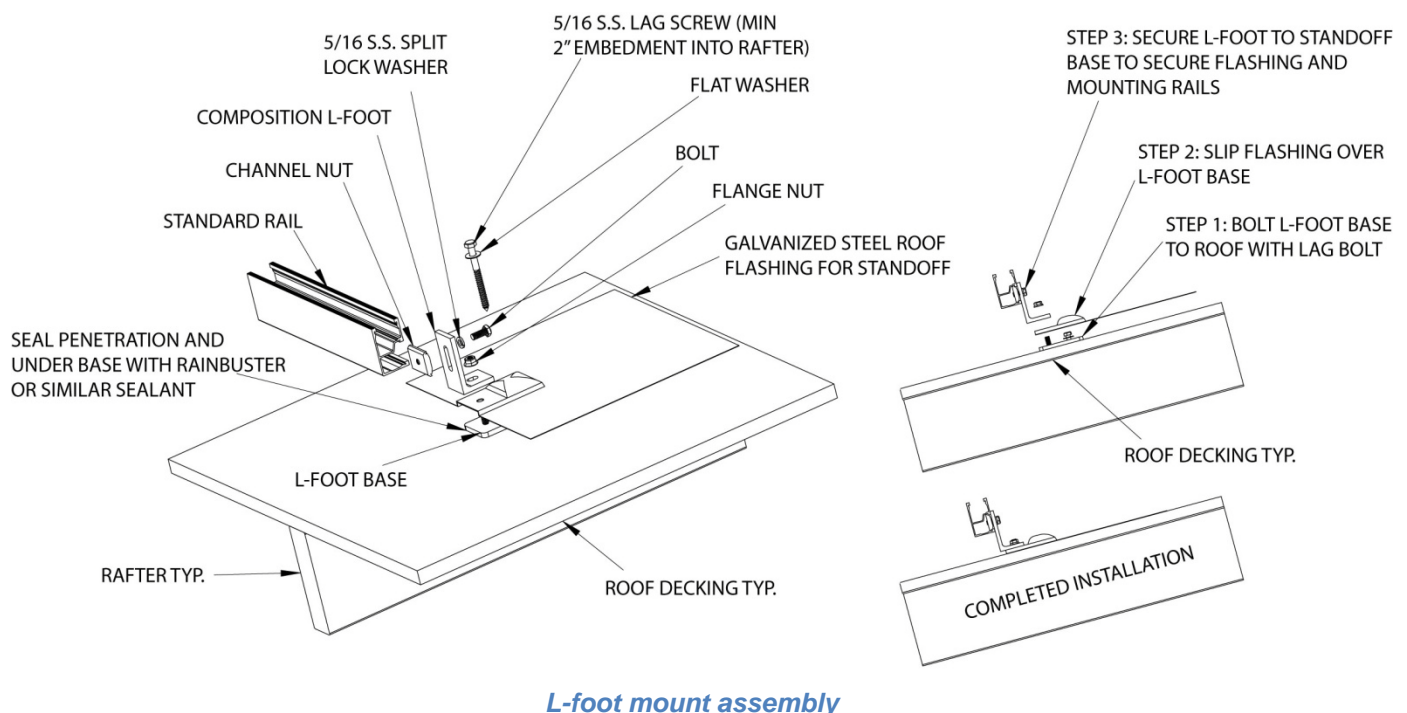
Confirm the location of the rafters by drilling pilot holes into the roof at each of the identified attachment points with a 3/16 inch pilot drill.

Be sure to drill the hole deep enough to penetrate the roof decking and enter the rafter by 1 to 1½ inches. If the drill *pushes through* at this point, you have likely missed the rafter and should move ½ inch laterally toward where you estimate the rafter to be and try again.

See the diagram below for L-foot mount assembly details.



Drill pilot holes



3.4 Secure base

Apply a bead of sealant to the underside of the L-foot base and into pilot hole.

Screw 5/16 inch lag bolts with lag bolt washers into the pilot holes and tighten with a ½ inch socket and socket adapter bit in a power drill.

Make sure the lag bolts used are long enough to embed at least 2 inches into the rafter to secure the L-foot base to the roof.



The required lag bolt length is based on the roof thickness as measured during the site evaluation.



Check that the lag bolts are secure with a socket and ratchet wrench.

If the bolt *spins out*, you didn't hit a rafter. Move ½ inch laterally towards where you estimate the rafter to be and try again starting with a new pilot hole.



L-foot base



Apply sealant and secure base to rafter

3.5 Install flashing

Insert the stamped-steel roof flashing over the L-foot base and underneath the upslope shingle.



Note: the L-foot base is different from the standoff base described in section 4 of this manual. Make sure you are using the correct part for the type of roof on which you are installing the array. See photos of each type on page 5.

3.6 Attach L-foot

Using a 5/16 inch nut and split lock washer, attach L-foot to L-foot base, securing the entire assembly to a rafter. Repeat this procedure for each L-foot base.



The orientation of the L-foot on top of the L-foot base is not critical and can be varied based on installer preference.



Check all bolt torques to ensure that all 5/16 inch hardware is tightened to 10 ft-lbs.

After installing all L-feet, go to section 6.



Install flashing



Secure L-foot to base



Installed L-foot assembly

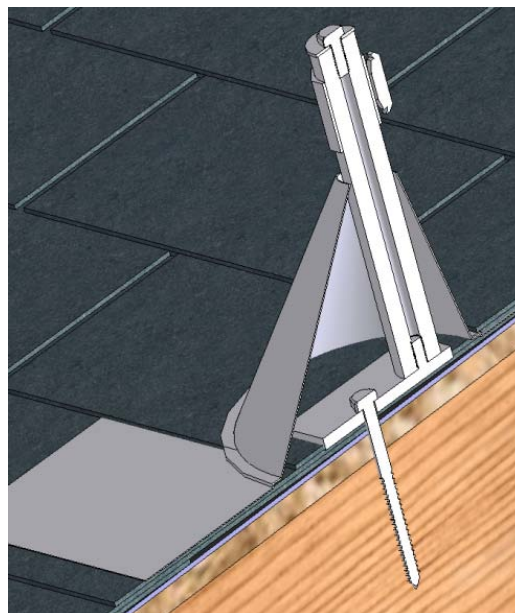
4. Flush mount on other roof types (using standoffs)

4.1 Introduction

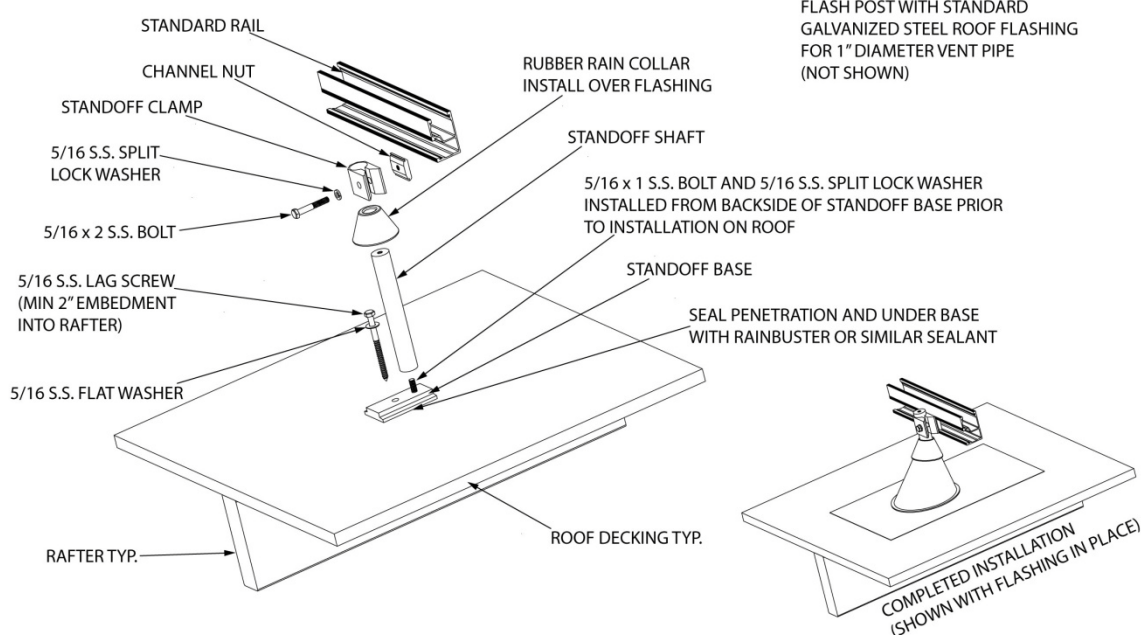
Typically, standoffs are used for installations on tile, shake, or special thick composition roof types.

For installations on standard composition roofs, use flashed L-feet as described in section 3. For installations where the PV modules will be installed tilted at an angle to the roof surface, see section 5.

Diagram below shows standoff mount assembly details.



Standoff section view



Standoff mount assembly

4.2 Determine type and size of attachment and flashing

Based on the construction type, style of the roof, and type of flashings to be used, determine the size of standoffs needed.

As a general rule, standoffs should be approximately 2½ inches taller than the cone of the flashing selected for the roof type. Some typical roof flashing heights are shown in the following list:



Standoff installation using Oatey flashing

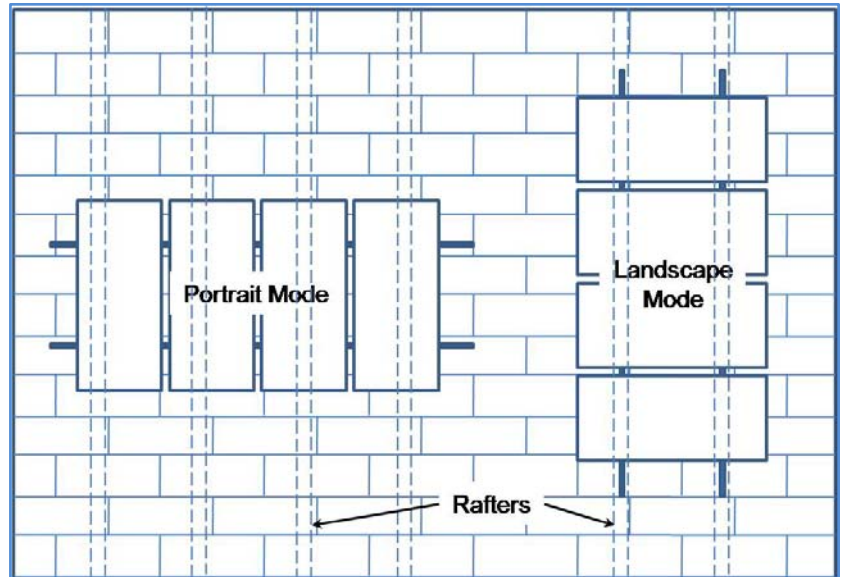
<i>Roof Type</i>	<i>Flashing Type</i>	<i>Flashing Height</i>	<i>Standoff Height</i>
Composition	Low profile Oatey	3 inches	5½ inches
Shake, Wood	Standard Galvanized Steel	4½ inches	7 inches
Flat Tile, Slate	Deadpan soft aluminum	6 inches	8½ inches
S or Mission Tile	Deadpan soft aluminum	7 inches (Same as above except lifted off roof)	10 inches

Flashing type and height recommendations

4.3 Locate attachment points

The location of attachment points for standoff mounts depends on the orientation of the modules relative to the rafters as shown in this diagram

Using the array layout plans and the estimated rafter locations, determine the location of all attachment points and mark the holes for each standoff base.

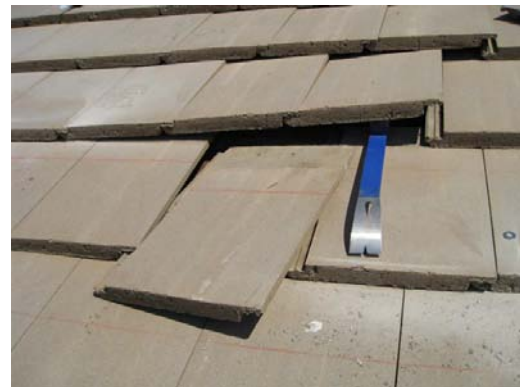


PV module orientation relative to rafters

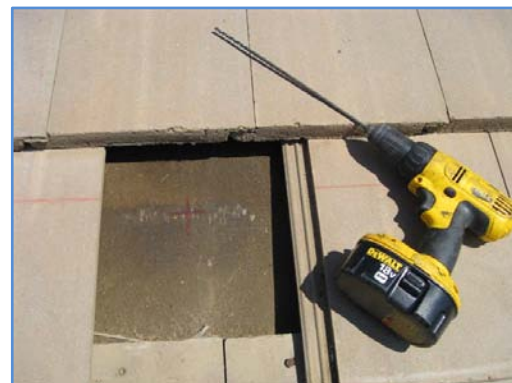
4.4 Mark attachment points

Remove the tile or shake underneath each standoff location, exposing the roofing underlayment. Transcribe the location marks from the roofing material to the roofing underlayment. Ensure that the standoff base lies flat on the underlayment, but remove no more material than required for the flashing to be installed properly.

Use the standoff base as a template to mark lag bolt hole locations on underlayment above the center of the rafters.



Remove roofing material to expose roof underlayment



Transcribe layout lines from roofing material to underlayment

4.5 Drill pilot holes

Confirm the location of the rafters by drilling pilot holes into the roof at each of the identified attachment points with a 3/16 inch pilot drill.

Be sure to drill the hole deep enough to penetrate the roof decking and enter the rafter by 1 inch to 1½ inch. If the drill *pushes through* at this point, you have likely missed a rafter and should move ½ inch laterally toward where you estimate the rafter to be and try again.



Drill pilot holes

4.6 Secure the base

Insert a 5/16 inch x 1 inch bolt and lock washer through the tapped hole in the standoff base and tighten.



This piece can be preassembled and taken out to the job site as one part.



Standoff base with bolt inserted



Note: the L-foot base is different from the standoff base described in section 3 of this manual. Make sure you are using the correct part for the type of roof on which you are installing the array. See photos of each type on page 5.



Apply sealant

Apply a bead of sealant to the underside of the standoff base and into the pilot hole.

Secure base to the roof by screwing 5/16 inch lag bolts with lag bolt washers into the pilot holes and tightening with a ½ inch socket and socket adapter bit in a power drill.

Make sure the lag bolts used are long enough to embed at least 2 inches into the rafter to secure the standoff base to the roof.



The required lag bolt length is based on the roof thickness as measured during the site evaluation.



Check that the lag bolts are secure with a socket and ratchet wrench.

If the bolt *spins out*, you didn't hit a rafter. Move ½ inch laterally toward where you estimate the rafter to be and try again starting with a new pilot hole.



Secure standoff base to rafter



Typical standoff base installation

4.7 Attach standoff and install flashing

Screw standoff shaft onto the base and tighten. Install flashing over the standoff shaft and base using standard building practices.

Apply a bead of sealant to seal the top of the flashing around the standoff shaft.

Slide rubber rain collar over the standoff and press down to cover the sealant at the top of the flashing.

Every standoff must be firmly secured to a rafter to ensure system integrity. Make sure that all lag screws are securely tightened into roof rafters and are structurally sound.

Repeat this procedure for each array attachment point. After installing all standoffs, go to section 6.



Screw standoff onto base



*Install flashing using appropriate methods for roof type.
Slide rain collar over flashing.*



Slide standoff clamp and hardware onto shaft over rain collar

5. Tilt mount (using standoffs and extensions)

5.1 Introduction

Installations that require the arrays to be tilted relative to the roof surface can be installed on either standoffs or L-feet as described in sections 3 and 4, but standoffs are the most common and are the only solution for flat roof surfaces where full flashings will be required.

For flush mounted (not tilted) installations on standard composition roofs, use flashed L-feet as described in section 3. For flush mounted arrays on thicker composition, shake, or tile roof types, use standoffs as described in section 4.



PV modules installed at shallow angle

5.2 Determine type of tilt assembly

There are two types of tilt assemblies for AEE Solar arrays depending on the amount of tilt required: shallow tilt assemblies for arrays installed at angles less than 15 degrees and full tilt assemblies for arrays installed at angles greater than 15 degrees (up to 45 degrees).

5.3 Shallow tilt kits

Tilt angles from 0 to 15 degrees can be configured as shown in the following diagram.

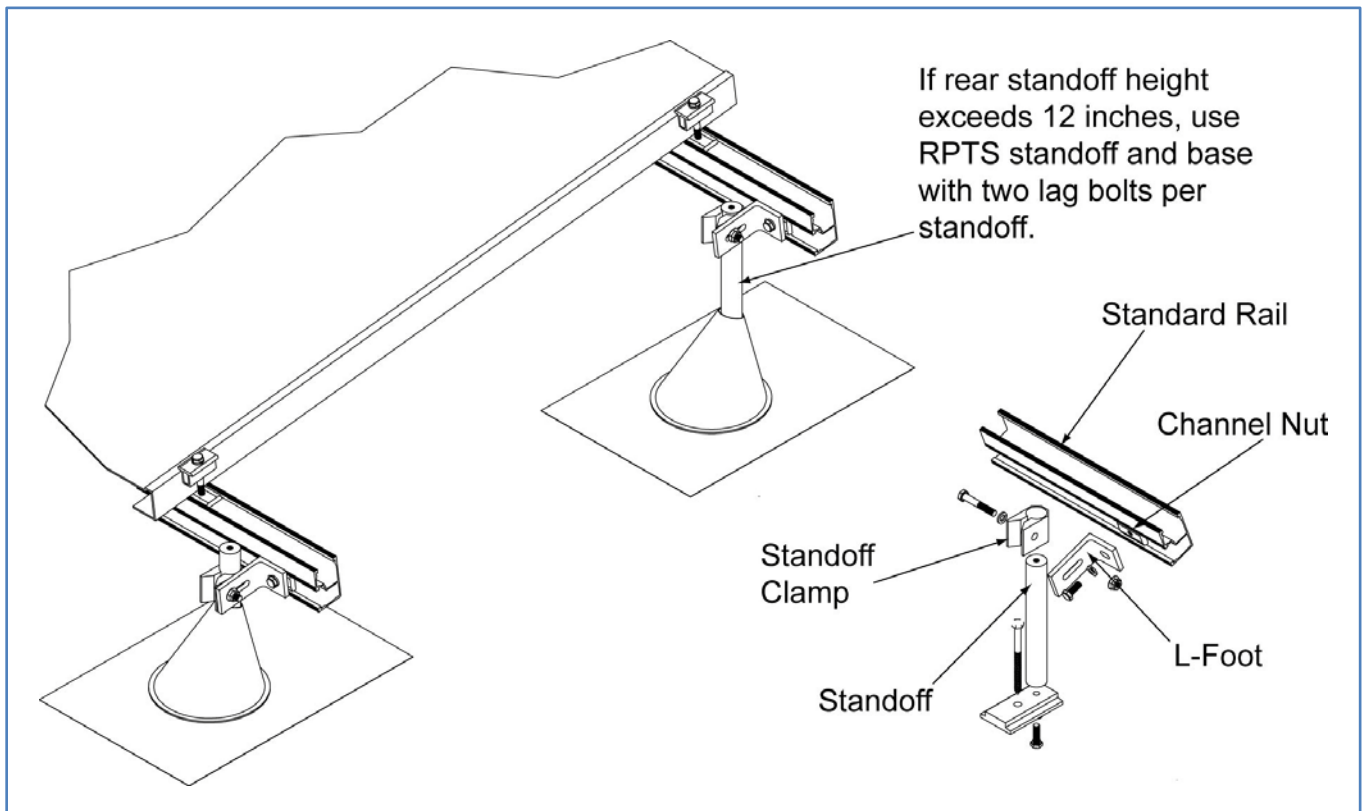
This configuration uses a standard length standoff for the lower rail and a longer standoff for the upper rail.

Calculate the length of the upper rail standoff to provide the desired module tilt angle. If the length of the upper standoff exceeds 12 inches, use the stronger SnapNrack RPTS standoff to achieve the height required.

For this type of installation, complete the layout and installation of standoffs as described in section 4.

Attach a standoff clamp and L-foot to each standoff, such that the rail can be bolted to the L-foot at the appropriate angle for the two rails to provide a flush mounting surface for the modules at the desired tilt angle.

Proceed with mounting rails and modules as described in section 6.



Tilt assembly for angles less than 15 degrees

5.4 Full tilt kits

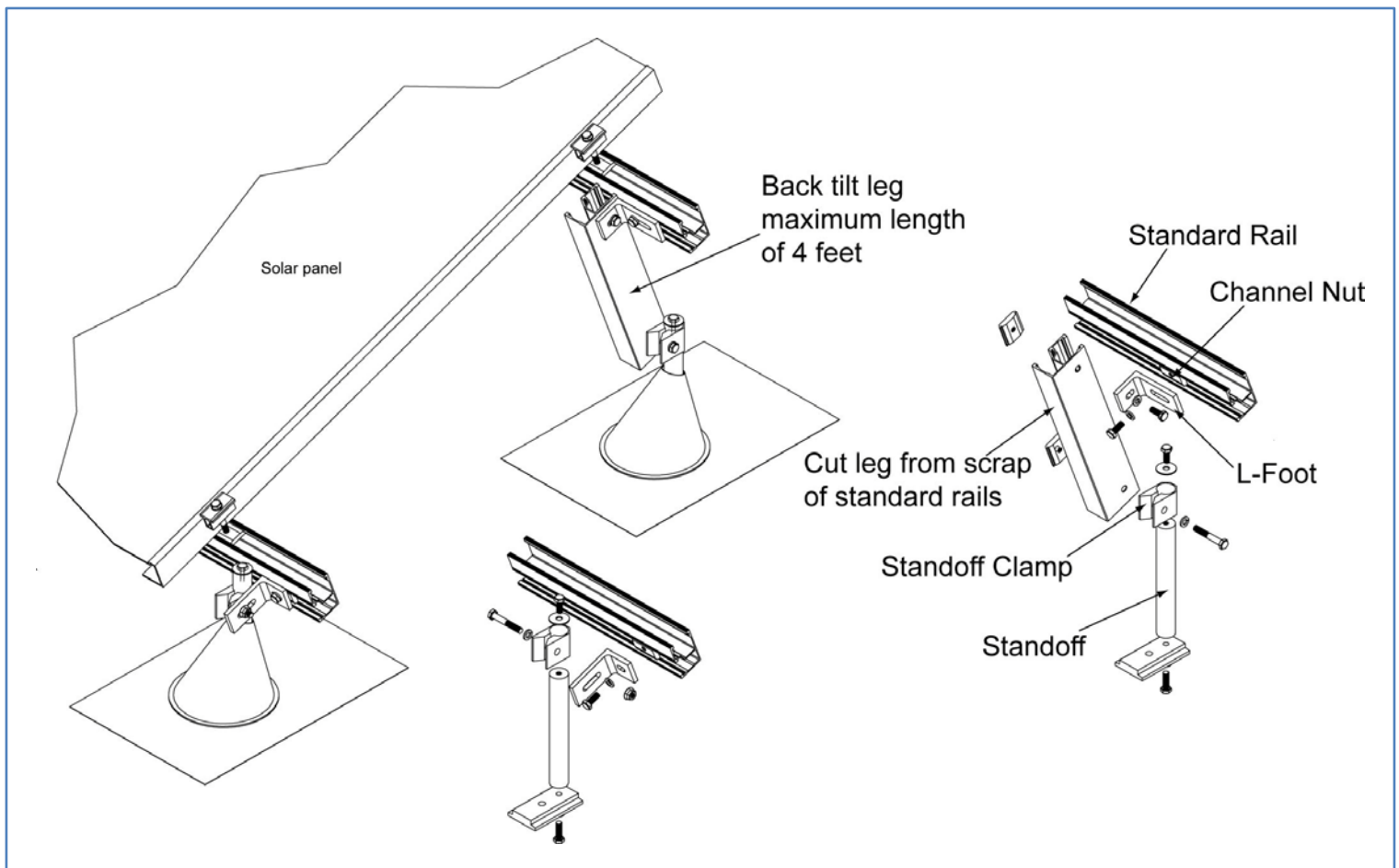
Tilt angles from 10 to 45 degrees can be configured as shown in the diagram on this page. This configuration uses a standard length standoff for both upper and lower rails and adds an extension to the standoff supporting the upper rail using a scrap of rail cut to the appropriate length and drilled with two holes.

Calculate the length of the upper rail standoff extension to provide the desired module tilt angle. If the length of the cut rail exceeds 4 feet, consult a structural engineer before proceeding.

Tilt leg rails can be cut and drilled ahead of time to save time on the job site. A simple drill guide will help with locating the holes in the tilt leg.

For this type of installation, complete the layout and installation of standoffs as shown in Section 4. Attach the lower or front rail mounting hardware as described in section 5.3 *Shallow Tilt Kits*.

Bolt the pre-drilled tilt leg rail to the standoff clamp on the back row of standoffs by passing a bolt through one of the holes in the rail and into a channel nut as shown in the drawing.



Tilt assembly for angles greater than 15 degrees

Similarly, bolt an L-foot to the upper end of the tilt leg rail and attach the upper rail to the L-foot.

Tighten all hardware at the appropriate angle for the two rails to provide a flush mounting surface for the modules at the desired module tilt angle.



Note that when tall tilt angles are used, the upper rail may seem a bit precarious until the first two or three modules are installed.

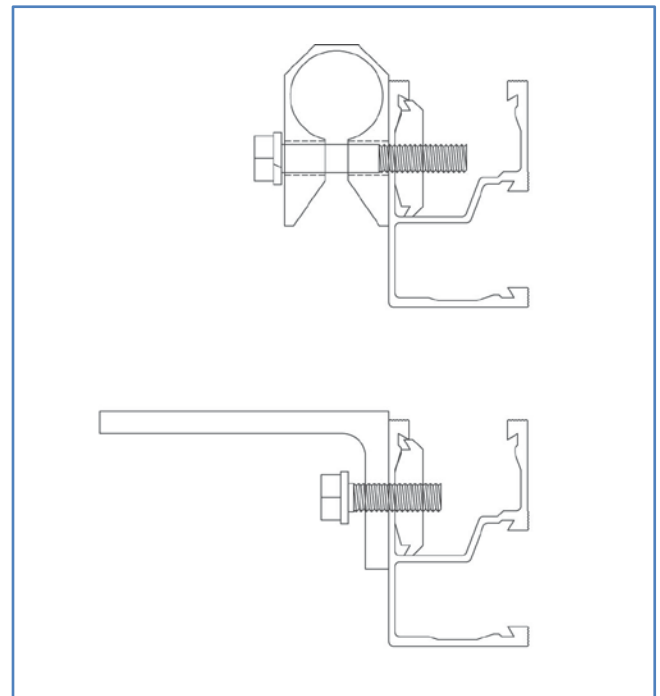
Take care that you don't put excessive moments on the rear leg standoffs such as to compromise their integrity over the duration of the installation.

Proceed with installing mounting rails and modules in Section 6.

5.5 Installing on L-feet

In some cases it may be desirable to install tilt kits on L-feet. Often, this is done when a row of modules along the top of a north facing roof slope is "tilted back" to match the south facing roof slope on the other side of the ridge line, and the building has a basic composition roof.

In these cases, proceed with installation as described in section 5.4 *Full Tilt Kits* substituting L-feet for the standoff/standoff clamp assemblies.



Rear tilt leg attachment configuration with L-feet
Note: requires drilling two holes in each rear tilt leg

6. Install rails

6.1 Snap in channel nuts

Snap in channel nuts and attach rails to mounting hardware using 5/16 inch bolts as shown in the photo.

Channel nuts are designed to snap in and out of rail channels. This enables you to quickly assemble systems without having to slide nuts from the end of a rail.

Rails can be mounted to either side of the L-feet or standoffs — upslope or downslope, as seen in the photos.



The rail nearest the low edge of the roof should be mounted in such a way that it presents an even, clean face as seen from the ground.

Leave bolts finger tight to facilitate rail leveling in the next section.



Snap in channel nut



Standard rail mounting configuration



Downslope mounted rail

7. Install rail splices

7.1 Snap in splice insert

At every junction of two rails, snap or slide in a rail splice insert and attach a rail splice top using 5/16 inch x $\frac{3}{4}$ inch bolts.

On long rails with multiple splices attach every other splice bar assembly with only one bolt so that the splice is free to allow for expansion and contraction. Be sure to leave a 1/8 inch gap between the rails.

Check all bolt torques to ensure that all 5/16 inch hardware is tightened to 10 ft-lbs.



Snap in splice insert



Tighten bolts on splice

8. Level rails

8.1 Overview

Rails can be leveled by raising or lowering the points where they attach to the L-foot or standoff assembly.

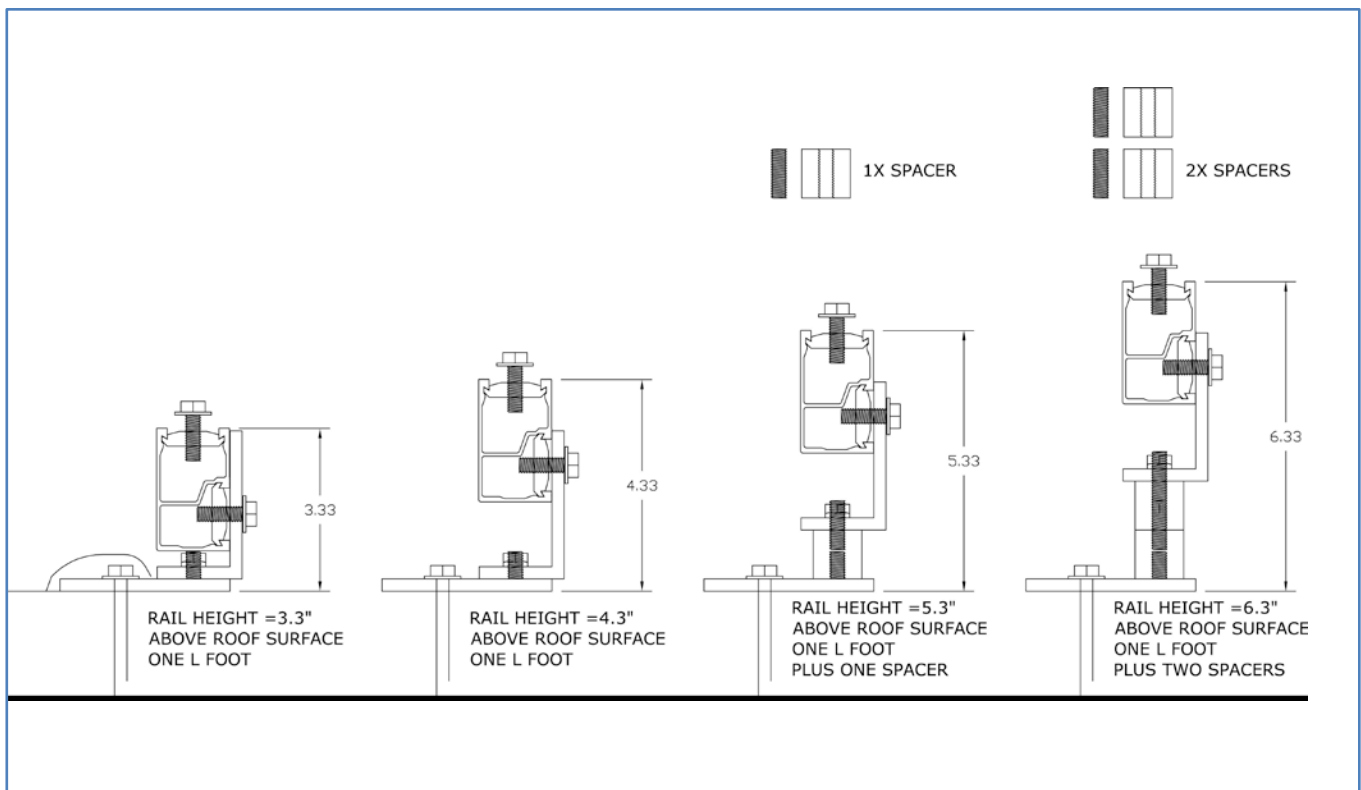
Up to 1 inch of adjustment is achieved with the basic sliding features built into both L-foot and standoff clamp components.

Use a spare rail or a string line to level the rails and make sure the tops of all of the rails are in the same plane.

8.2 Additional leveling for L-foot mounted rails

An additional 1 inch or 2 inches of height can be added by installing one or two 1 inch standoff spacers between the L-foot and its base. When necessary, use spacers as follows:

- Remove L-foot.
- Thread 1 inch standoff onto standoff bases threaded stud.
- Screw 1 inch set screw into 1 inch standoff with 5/32 inch Allen wrench.



Up to three inches of leveling capability for L-foot mounts

- Reinstall L-foot as before by tightening the original nut and lock washer onto the threads of the set screw.
- Repeat process to add a second 1 inch spacer if needed.

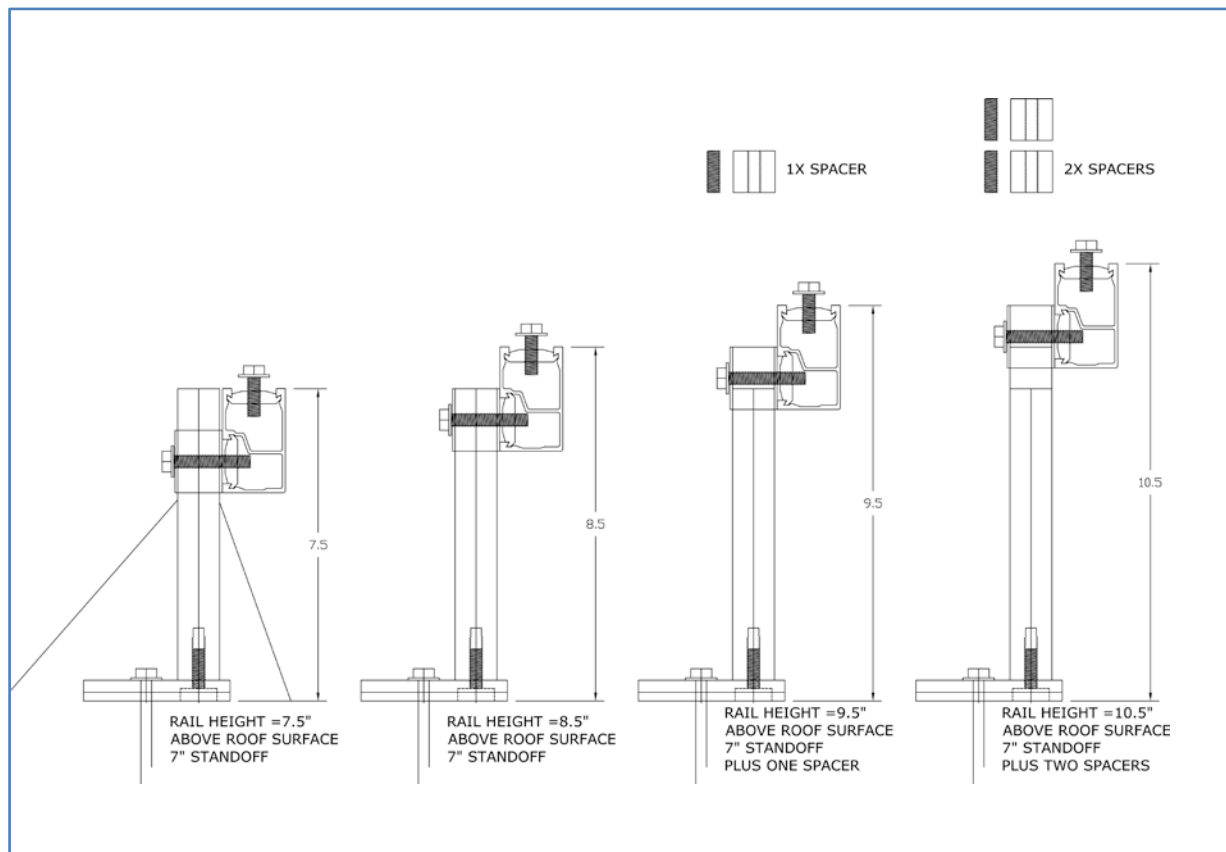


Check all bolt torques to ensure that all 5/16 hardware is tightened to 10 ft-lbs.

8.3 Additional leveling for standoff mounted rails

An additional 1 inch or 2 inches of height can be added by installing one or two 1 inch standoff spacers to the top of the standoff shaft. When it is necessary to use spacers, adjust the level as follows:

- Remove standoff clamp or simply slide down standoff shaft.
- Screw 1 inch threaded stud into top of standoff so that half the threads are into the standoff.
- Thread 1 inch spacer onto set screw using 5/32 inch Allen key to hold set screw still and ensure even thread engagement into both shafts.
- Reinstall standoff clamp as before.
- Repeat process to add a second 1 inch spacer if needed.



Up to three inches of leveling capability for standoff mounts



Check all bolt torques to ensure that all 5/16 inch hardware is tightened to 10 ft-lbs.



If the standoff clamp extends above the top surface of the standoff, spacers need to be added.



Never use more than two spacers. If more height is required, use a taller standoff.

9. Install modules on rails

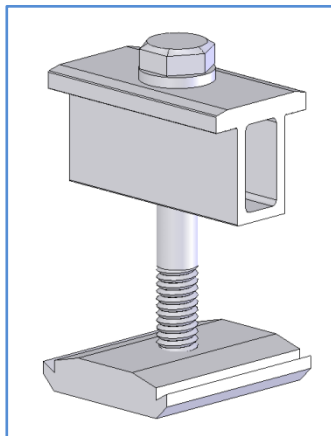
9.1 Prepare clamping hardware

Preassemble module clamping hardware. Each clamp assembly consists of a module clamp, a channel nut, and a 5/16 inch bolt and split lock washer.

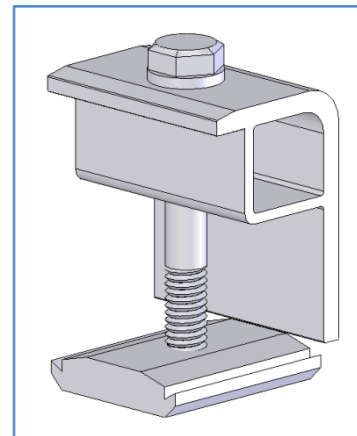
The end clip size and bolt length are specific to the thickness of the module. Make sure you have the right size of each of these components for the modules being installed.



Snap module clamp assemblies into rail



Mid clamp



End clamp

To speed the installation, measure out the location of mid-clamps and end clamps on rails with a tape measure.

Snap in clamps on all the rails so the clamps will be ready when you place the modules.

9.2 Set first module

Place the first module, taking care to line the module up to the rails and roof edges.

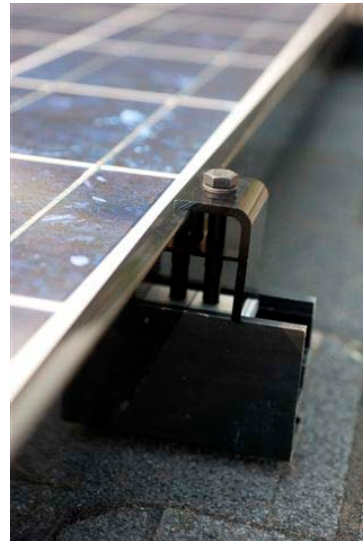


The rest of the installation will go more smoothly if you take the time to get the first module lined up properly.

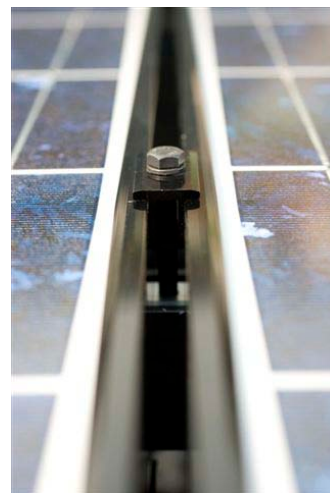
Tighten the two end clamps on the first module and snap in the next two clamps, which will typically be mid clamps, to prepare to receive the next module.

Proceed down the row placing one module at a time and tightening clamps as you go.

When you place the last module in the row, secure it with end clamps to finish the row and repeat the process for the next row of modules.



Installed end clamp



Installed mid clamp



Installing modules

9.3 Connect wiring

Connect module leads and train the wires into the rail channels as the modules are being installed. This will ensure a clean, robust electrical installation with no dangling wires. Use module lead clips as necessary to insure that module leads are secured to module frames until they drop into the rail channel.



Connect wiring

9.4 Connect grounds

Install grounding hardware per PV module manufacturer's specifications.

It is often convenient to install grounding hardware as modules are being installed but this will vary with the type of PV modules used.



Connect grounds

9.5 Trim rails

Trim rail ends to leave about ½ inch of rail extending past the end of all module end clips.

Take care not to cut into the roof surface with the saw while trimming rails.

File off rail ends with a hand file and vacuum up metal shavings.

Careful array layout will enable you to cut rails before they are installed on the roof.



Trim rails

10. Final check

10.1 Check security of modules

Grab module frames and gently push up and down in various locations around the array to ensure that nothing moves.

10.2 Check tightness of all bolts

Check all bolt torques to ensure that all 5/16 inch hardware is tightened to 10 ft-lbs.

10.3 Check wires and grounds

Check under the array to ensure all wires are tucked up with module clips along the module frames and trained into the cable channels in the rails.



Check all bolts



Check under the array for dangling wires

11. Appendix

11.1 Engineering certification letter



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SnapNRack Residential Racking System

Date: January 23, 2009
To: Tim Vaughn
AEE Solar, Inc.
From: Matthew Gilliss
Taylor & Syfan Consulting Engineers
Project: SnapNRack Residential Racking System
T&S Job No.: 7456

Subject: Project Summary, SnapNRack Residential Racking System

Tim,

This Project Summary Letter is in reference to the Structural Calculation Packet for the new SnapNRack Residential Racking System dated March 28, 2008. The calculations have been performed in accordance to the 2007 California Building Code (CBC), the governing structural code in California which is based on the 2006 International Building Code (IBC) and also references the ASCE 7-05 Standard. Several factors contained within these codes govern the overall design of the racking system which has been designed (under certain conditions to be discussed later) to withstand forces due to the racking systems own weight, the weight of the solar panels, and wind forces which may induce both compressive and uplift forces on the panels and the racking system.

In terms of variable conditions for the racking system, the main rails which support the solar panels (referred to as the "rail standard") have an adjustable length, which is the distance between where they are attached to the roof (called standoffs). For the purpose of the calculation packet, that length was taken to be 8'-0", 6'-0", or 4'-0".

Based on the many variables that are required to take into account during a wind analysis, we have come up with 50 possible cases that we feel are the most common. These cases are based on a number of factors which include wind speed, building height, pitch of the panels, wind exposure region, and topographic factors. We have found that the rails will be able to span a maximum of 8'-0" for most of the common cases, but that there are certain cases that will require shorter spans and/or a location sensitive analysis to be performed on a case by case basis if it is found that the location of the solar panel install falls within one of the following criteria:

- The total pitch of the solar panel (solar panel pitch & roof pitch) is greater than 45 degrees above the horizontal.

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SnapNRack Residential Racking System

- A topographic factor applies to the location. Topographic factors apply, for general purposes, when the construction area is on, or near the top of a hill or mesa, on the edge of a bluff, or overlooking a large body of water. For the exact definition of what a topographic factor is, please see ASCE 7-05, section 6.5.7.
- The roof of the structure that the solar panels will be installed on is taller than 40 ft. above the natural grade.

If one of more of these factors applies to the project location, please contact Taylor & Syfan and we will be happy to check the site conditions and recommend a standoff spacing for each specific site.

Also contained within the calculation packet are calculations for the connection of the rails to the roof rafters. Using the sizes provided by AEE, we have calculated the maximum forces that will be resisted based on the withdraw value of the lag screws, and the aluminum components which are involved in transferring these forces from the rail to the roof rafters. The results from this have been integrated into this report and can be found in the summary charts (attached).

The attached pages of this summary contain what we feel are some of the most common building configurations with varying wind speeds. These charts can be used as a quick reference for looking up maximum rail span lengths based on the building conditions, but it is to be noted that for any building where a topographic factor is to be applied (tops of hills, mesas, or coastal bluffs) the rail span lengths given are only educated guesses for the given site condition. A structural engineer should calculate the exact topographic factor for this specific site prior to construction.

In addition, the "Tilt Kit" option of mounting the panels to the rails as shown in AEE's drawings "Res-Tilt1" and "Res-Tilt2" (dated 10/24/08) has been analyzed and is a structurally acceptable option for mounting the solar panels to the existing residential roof. This statement is made under the condition that the rail span guidelines given within this packet are followed.

Please note that all sizes, material specifications, and weights have been provided by AEE Solar. All waterproofing issues involved in connecting the racking system to the roof are the responsibility of AEE Solar. This summary letter was written to discuss the adequacy of the solar racking system only and does not validate the adequacy of the structure the racking system is being placed on.

Please feel free to contact me with any questions or concerns. Thank you.

Sincerely,

A handwritten signature in blue ink that reads "Matthew B. Gilliss".

Matthew B. Gilliss
 Project Engineer
 Taylor & Syfan Consulting Engineers

11.2 Rail span tables

MAXIMUM RAIL SPANS BETWEEN STANDOFFS (FT.)

Case	Conditions	Windspeed (Nominal 3-sec. Gust in mph)				
		85	90	105	130	150
1 – 5	0 to 27 Degree Pitch Building Ht. ≤ 25 ft. No Topo. Factors	8	8	8	6	6
6 – 10	0 to 27 Degree Pitch Building Ht. up to 40 ft. No Topo. Factors	8	8	8	6	4
11 – 15	0 to 27 Degree Pitch Building Ht. ≤ 25 ft. Top of Hill	8	8	8	6	4
16 – 20	0 to 27 Degree Pitch Building Ht. up to 40 ft. Top of Hill	8	8	8	4	4
21 – 25	0 to 27 Degree Pitch Building Ht. ≤ 25 ft. Coastal Condition	8	8	6	4	4*
26 – 30	0 to 27 Degree Pitch Building Ht. up to 40 ft. Coastal Condition	8	8	6	4	4*
31 – 35	0 to 27 Degree Pitch Building Ht. ≤ 25 ft. Mesa Condition	8	8	6	4	4*
36 – 40	0 to 27 Degree Pitch Building Ht. up to 40 ft. Mesa Condition	8	6	4	4*	4*
41 – 45	0 to 27 Degree Pitch Building Ht. up to 40 ft. 20 psf Snow Load	6	6	4	4	4
46 – 50	0 to 27 Degree Pitch Building Ht. up to 40 ft. 40 psf Snow Load	4	4	4	4	4

* = Must increase lag screw uplift capacity by either increasing embedment depth, or diameter.
Contact Taylor & Syfan for Clarification.

This chart can be used as a quick reference for looking up maximum rail span lengths based on the the building conditions, but it is to be noted that for any building where a topographic factor is to be applied (tops of hills, mesas, or coastal bluffs) the rail span lengths given are only educated guesses for the given site condition. A structural engineer should calculate the exact topographic factor for this specific site prior to construction.

MAXIMUM RAIL SPANS BETWEEN STANDOFFS (FT.)

Case	Conditions	Windspeed (Nominal 3-sec. Gust in mph)				
		85	90	105	130	150
1 – 5	28 to 45 Degree Pitch Building Ht. ≤ 25 ft. No Topo. Factors	8	6	4	4*	4*
6 – 10	28 to 45 Degree Pitch Building Ht. up to 40 ft. No Topo. Factors	6	6	4	4*	4*
11 – 15	28 to 45 Degree Pitch Building Ht. ≤ 25 ft. Top of Hill	6	4	4*	4*	4*
16 – 20	28 to 45 Degree Pitch Building Ht. up to 40 ft. Top of Hill	4	4	4*	4*	4*
21 – 25	28 to 45 Degree Pitch Building Ht. ≤ 25 ft. Coastal Condition	4	4	4*	4*	4*
26 – 30	28 to 45 Degree Pitch Building Ht. up to 40 ft. Coastal Condition	4	4*	4*	4*	4*
31 – 35	28 to 45 Degree Pitch Building Ht. ≤ 25 ft. Mesa Condition	4*	4*	4*	4*	4*
36 – 40	28 to 45 Degree Pitch Building Ht. up to 40 ft. Mesa Condition	4*	4*	4*	4*	4*
41 – 45	28 to 45 Degree Pitch Building Ht. up to 40 ft. 20 psf Snow Load	6	6	4	4*	4*
46 – 50	28 to 45 Degree Pitch Building Ht. up to 40 ft. 40 psf Snow Load	6	6	4	4*	4*

* = Must increase lag screw uplift capacity by either increasing embedment depth, or diameter.
Contact Taylor & Syfan for Clarification.

This chart can be used as a quick reference for looking up maximum rail span lengths based on the the building conditions, but it is to be noted that for any building where a topographic factor is to be applied (top 1/2 of hills, mesas, or coastal bluffs) the rail span lengths given are only educated guesses for the given site condition. A structural engineer should calculate the exact topographic factor for this specific site prior to construction.

11.3 SnapNrack Warranty

SnapNrack™



10 year Limited Product Warranty and 5 year Limited Finish Warranty

Limited Warranties: AEE Solar, Inc., ("AEE Solar") warrants to the original end-user of the Product ("Purchaser") at the original installation site ("Site") that the SnapNrack™ PV module mounting system (the "Product") shall be free from defects in materials and workmanship for a period of **ten (10) years** (the "Limited Product Warranty"), and the Product's anodized finish shall be free from visible peeling, cracking or chalking under normal atmospheric conditions for a period of **five (5) years** (the "Limited Finish Warranty") (collectively, the "Limited Warranties"). The Limited Warranties shall commence on the earlier of 1) the date the installation of the Product as part of the original solar electric system (the "System") is complete, or 2) thirty (30) days after AEE Solar ships the Product to the authorized distributor or retailer. If within the warranted period the Product is determined by AEE Solar, based on reasonable evidence of a defect provided by Purchaser, AEE Solar will, at its sole option, (a) repair the Product or replace it with an equivalent product, or (b) take back the Product and refund the purchase price to the Purchaser.

Conditions, Limitations and Exclusions: AEE Solar is not responsible for, and Purchaser hereby agrees to bear, the costs of any on-site labor and any costs associated with the installation, removal, reinstallation, shipping or transportation of the Product or any components thereof for replacement or service. (Note: the foregoing may not be applicable to consumer sales in certain jurisdictions.) AEE Solar may, at its sole discretion, use new, remanufactured or refurbished parts or products when repairing or replacing your Product under this warranty. Any exchanged or replaced parts or products will become the property of AEE Solar. This warranty is extended only to the original end-user purchaser and is not transferable, provided that as long as the System has not been physically moved or altered, any subsequent owner of the System shall have the same Limited Warranty rights as the original Purchaser.

The Limited Warranties do not apply to Products installed (a) outside the U.S.A. or Canada, or (b) in corrosive atmospheric conditions, including, but not limited to chemical fumes, salt spray, acidic rain or surface temperatures which exceed 200 degrees Fahrenheit. The Limited Warranties do not cover damage to the Product's anodized finish caused by moisture, condensation, or other contamination resulting from improper storage, packing or handling. The Limited Warranties do not cover damage to the Product that occurs during shipment or prior to or during installation. The Limited Warranties shall be void if the Product is not installed in accordance with AEE Solar's written installation instructions for the Product, or if the Product has been modified, repaired, or reworked in a manner not previously authorized by AEE Solar in writing, or if

SnapNrack Warranty (Feb. 2009)

the Product is installed in an environment for which it was not designed.

As used herein, the term "chalking" refers to the powdery residue formed by the breakdown of the anodized finish, and excludes any foreign residue deposited on the finish by the surrounding atmosphere, including, but not limited to, soot, dust, plaster, cement, etc. The Limited Finish Warranty is void if normal maintenance and cleaning practices are not followed by Purchaser as specified by AAMA 609 & 610-02 — "Cleaning and Maintenance for Architecturally Finished Aluminum," a copy of which is available from AEE Solar or from www.aamanet.org.

AEE SOLAR MAKES NO WARRANTIES, EXPRESS OR IMPLIED, OTHER THAN THE LIMITED WARRANTIES MADE HEREIN. AEE SOLAR EXPRESSLY DISCLAIMS ALL OTHER WARRANTIES, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, TO THE FULLEST EXTENT PERMITTED BY LAW. TO THE EXTENT THAT ANY SUCH IMPLIED WARRANTIES CANNOT BE FULLY DISCLAIMED AS A MATTER OF LAW, THEY ARE LIMITED IN DURATION TO TEN (10) YEARS FROM THE DATE OF ORIGINAL PURCHASE.

TO THE FULLEST EXTENT PERMITTED BY LAW, AEE SOLAR DISCLAIMS ANY LIABILITY WHATSOEVER FOR ANY SPECIAL, INCIDENTAL, CONSEQUENTIAL OR PUNITIVE DAMAGES ARISING FROM THE USE OF THE PRODUCT, OR FOR OTHER LOSS OR INJURY RESULTING FROM ANY CAUSE OF WHATSOEVER ARISING OUT OF OR RELATED TO THE PRODUCT, INCLUDING BUT NOT LIMITED TO DAMAGE OR INJURY TO PERSONS OR PROPERTY, DAMAGES FOR LOST SERVICES, COST OF SUBSTITUTE SERVICES, LOST PROFITS OR SAVINGS, AND EXPENSES ARISING OUT OF THIRD PARTY CLAIMS.

AEE SOLAR'S MAXIMUM LIABILITY UNDER ANY THEORY OF LIABILITY, WHETHER EXPRESS, IMPLIED OR STATUTORY, OR FOR ANY MANUFACTURING OR DESIGN DEFECTS, IS LIMITED TO THE ORIGINAL PURCHASE PRICE OF THE PRODUCT.

To the fullest extent permitted by law, Purchaser's remedies for breach of warranty, or for manufacturing or design defects, shall be only as stated herein. AEE Solar's Limited Warranty covers only the Product, and not related items such as PV modules, roof flashings and specialized clamps. Manufacturers of such related items typically provide written warranties of their own.

Warranty Procedure: Purchaser should contact the distributor or retailer where the Product was purchased, or if unable to do so, contact AEE Solar customer service at: (800) 777-6609, customerservice@aeesolar.com or AEE Solar, Inc., P.O. Box 1155 Redway CA 95560.