



# Prepping for PV

## Installing & Flashing PV Roof Mounts

All photos courtesy Quick Mount PV

Story & photos by Johan Alfsen

There are online instructional videos to teach just about everything—from playing your favorite guitar riff to installing dual-pane windows. But when you search for “how to mount PV modules on the roof,” you will most likely get an outdated video showing improper roof penetrations that actually void roof warranties and violate roofing codes and standards.

Only in the past few years have manufacturers designed mounting and waterproof flashing systems that are easy to install and meet the codes (see “Modern PV Roof Mounting” in *HP137*). Here is a step-by-step explanation for installing a code-compliant rack system on a composition/asphalt shingle roof.

### Before You Start

**Safety & roofing.** Working on a roof can be dangerous and OSHA safety standards should always be followed (see [www.osha.gov/dep/greenjobs/solar\\_falls.html](http://www.osha.gov/dep/greenjobs/solar_falls.html)). Roof warranties should also be considered. The roof’s condition will need to be evaluated to determine if a new roof will be needed.

If not, contact the original roofing company to determine if there are any workmanship and product warranties that might be affected. If a new roof is going to be installed prior to installing the PV system, stand-off posts can be attached, which can then be flashed and waterproofed by the roofers as they install the new roof.

**Layout & Attachment.** Plan ahead so that you know how many roof penetrations need to be made—prior to stepping onto the roof. Online rack calculators or manufacturer specifications can help determine the proper number of roof attachments needed for your system and location (see Access).

Proper attachment to the roof structure is key to a strong rack system. If possible, it is best to attach additional wood blocking between rafters. When blocking is not an option, then you must pre-drill into the rafter and attach with a lag bolt or hanger bolt. Staggering the mounts on the roof to avoid attaching every rail to the same rafter helps distribute the load.

## Pro Tips:

1. Over the years, my crew has used all lengths and diameters of lag screws—but that changed after we discovered the Simpson 1/4 by 3 inch hot-dip, galvanized, strong drive lags, which require no pilot hole and drive easily with an impact driver. Plus, the inspectors and plan checkers seem to like seeing the brand on the plans. The 1/4-inch-diameter is less likely to split a 2-by truss.
2. Finding the center of a truss is critical and test holes are a necessary evil. We use landscape flags to probe pilot holes. The thin wire will prove if you have hit a truss. If you miss the truss, bend a slight angle into the wire and rotate it until the end strikes the side of the truss. Extract the wire and hold it in the same orientation as when you touched the side of the truss and it will tell you accurately where the truss edge is. If someone needs to crawl into the attic to put in blocking, wind the flag tightly around the wire and insert it into the pilot hole—it will unfurl and be easy to spot, even in the dustiest attic.

—William Miller • [www.millersolar.com](http://www.millersolar.com)

A common method of finding rafters is to transfer measurement points from inside the attic to the roof. If attic access is not an option, there are other methods and tricks that you can use. Looking at the gutters and bays from the ground, use a mallet to gently knock and determine rafter placement, or use a deep scan rafter finder. As a last resort, you can also use a small (typically 5/32-inch) bit to drill through the roof to find the rafters. If the bit misses the rafter, you can then use a wire coat hanger to fish through the hole and locate the rafter. Be sure to seal any holes you've made.

Once the rafter layout is determined, make chalk lines down the roof to mark the rafters and across the roof for your rail placement.

### Choosing Your Product

There are a variety of code-compliant mounting and flashing products on the market. Before you buy, consider the following things.

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## On an Existing Roof...



### Step 1

Lay out chalk lines, then gently break the seal between shingles. This can be done with a “shingle ripper” or “slate bar” tool, which can also be used to remove any nails that prevent the flashing from going into position. The flashing’s bottom edge should never extend beyond the drip edge of the shingle. Before drilling, place the flashing in its correct position and mark the exact pre-drill point.

### Step 2

Once rafters are located and marked, and the post position is determined, drill a 7/32-inch pilot hole into the center of the rafter and fill with the roof manufacturer’s approved sealant. Be sure to drill the pilot hole 90° to the pitch of the roof. Pilot holes are used to prevent splitting the wood with your lag screw (or hanger bolt). The size of the pilot drill bit should be about 60% to 70% of the screw that is being installed. For example, if your lag size is 5/16, then your pilot drill bit should be about 7/32 or 1/4 inch.



## roof mounts

- **Roofing code-compliance**— The International Building Code (IBC) calls for flashing to be installed on all roof penetrations. A minimum of 4 inches of flashing should be on each side of the roof penetration to divert wind-driven rain.
- **Product certification (Example: ICC-ES)**—There are product evaluation services such as ICC-ES that perform technical evaluations to determine that products comply with codes and standards.
- **Approval from roofing material manufacturers**— Many roof manufacturers, such as GAF & Owens Corning, will test and evaluate products for warranty approval. It is important that your flashing/mount does not void the roof manufacturer's warranty.
- **Mount engineering strength**—The rail will govern how many mounts need to be installed based on the span charts. Mounts are tested for pull-out and shear strength. A well-engineered mount will allow further spans and fewer penetrations in the roof.
- **Ease of installation**—After the rafters are located, a well-designed mount/flashing should only take a few minutes to install. Spending less time on the roof brings down labor costs and promotes a safer work environment.
- **Product longevity and life span of materials**—The waterproof flashing and mount should have a life span that meets or exceeds the life of the roof and/or the system. Galvanized flashings only have about a 15-year life span, while aluminum has a 50-year life span. The

## Existing Roof, cont.



### Step 3

Slide the flashing under the shingle to align with your chalk lines and pre-drilled pilot hole.



### Step 4

Drive the hanger bolt with its sealing washer into the rafter to the correct torque specifications listed by the manufacturer.

Sheet Metal & Air Conditioning Contractors' National Association (SMACNA) states that galvanized flashings should not be installed on roofs that will exceed 15 years.

Many manufacturers have this information on their websites. Obtaining a product sample for personal inspection can help verify the quality of the product being used, noting the workmanship, and weight, thickness, and size of the material.

No matter what product you choose, always follow the manufacturer's installation instructions. Many manufacturers provide installation videos. While they may not teach you how to play your favorite guitar lick, they will certainly help you install code-compliant mounting and flashing solutions for your roof.

### Access

Johan Alfsen got his start in the solar industry as an installer. Currently, he is the training manager for Quick Mount PV.

### Resources:

- Direct Power & Water • [www.dpwsolar.com](http://www.dpwsolar.com)
- EcoFasten • [www.ecofastensolar.com](http://www.ecofastensolar.com)
- Haticon • [www.haticonsolar.com](http://www.haticonsolar.com)
- IronRidge • [www.ironridge.com](http://www.ironridge.com) • Rooftop mount configurator
- Oatey • [www.oatey.com](http://www.oatey.com) • Flashing
- Pro Solar • [www.prosolar.com](http://www.prosolar.com)
- Quick Mount PV • [www.quickmountpv.com](http://www.quickmountpv.com)
- SnapNrack • [www.snapnrack.com](http://www.snapnrack.com)
- TerraSmart • [www.terrasmart.com](http://www.terrasmart.com)
- Thompson Technology Industries • [www.thompsonotec.com](http://www.thompsonotec.com)
- Unirac • [www.unirac.com](http://www.unirac.com)
- Zilla • [www.zillarc.com](http://www.zillarc.com)



### Step 5

Cap off the block with an EPDM sealing washer to prevent standing water in the mounting block's hole. EPDM is a high-heat-resistance rubber that works well with PV system mount components.

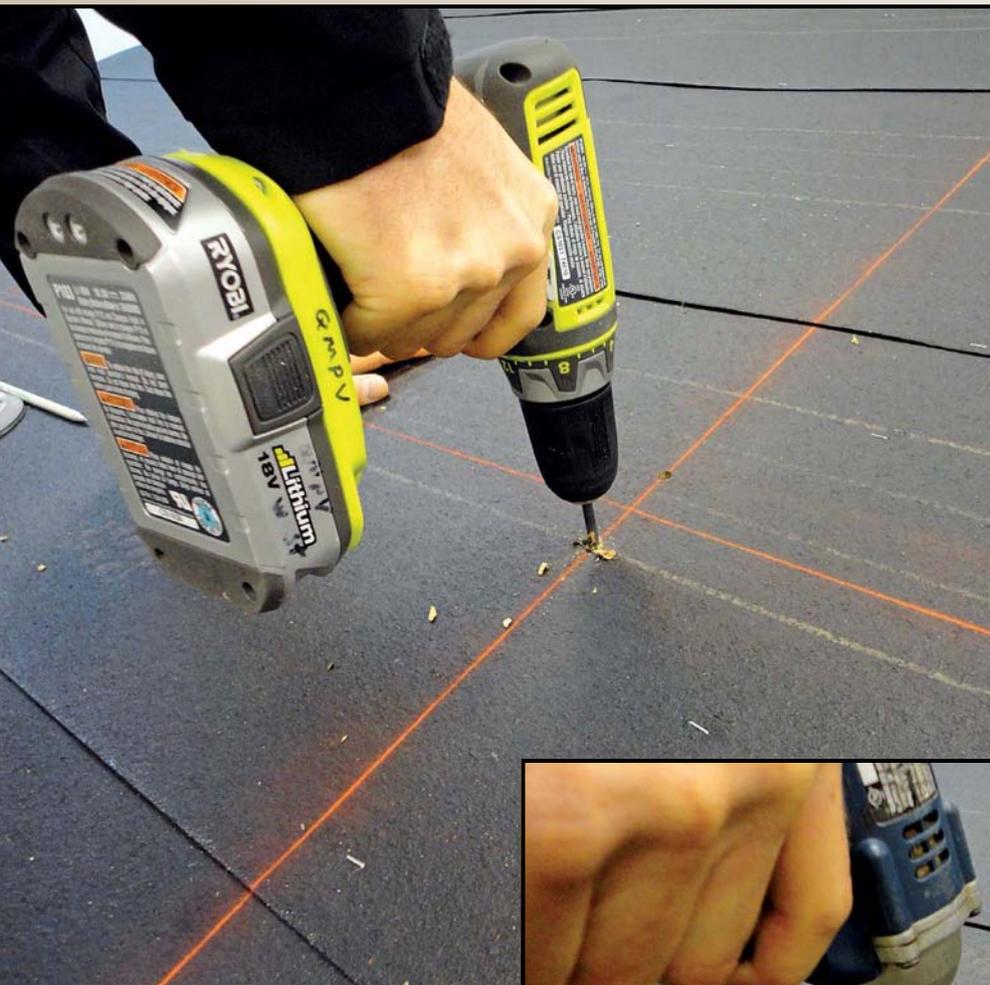
### Step 6

Attach the rack system to the mount and proceed with your PV installation! This picture shows a standard L-bracket that is fastened with a fender washer, a lock washer, and a nut. Most all-in-one flashing and mount products are designed to be compatible with standard PV racking systems. This example shows Quick Mount PV mounts with Iron Ridge rails.



# On a New Roof...

For existing roof installations, many PV installers use integrated flashing and mounting solutions as shown above. Many of the same mounting/ flashing products can be used on new roofs after the roof is installed, but standard post and flashing systems are more common on new roofs. Before the roofing is installed, you can attach your stand-off posts and then the roofers can install separate waterproof flashing as they shingle the roof. This allows the roofers to ensure the waterproofing is done well, maintaining the roofing warranty.



## Step 1

Determine the design layout and check the roof's integrity, then locate the rafters and set chalk lines. Align the base-plate vertical holes with rafter chalk lines and mark holes for drilling. Drill your pilot holes into the center of the rafter. Then fill the pilot holes with the appropriate sealant. Note: Not all sealants are compatible with shingles. Most roofing manufacturers will list an approved or recommended sealant so as not to cause chemical breakdown and deterioration of the roofing material. Common sealants include GeoCell 2300 or ChemLink M1.



## Step 2

Attach your mount. For this particular product, you will insert a grade-8 bolt through the backside of the base plate. Then, line up the base's vertical holes with your pre-drilled pilot holes and drive two 3-inch lag bolts into the rafter with an impact drill.

### Step 3

Attach the post to the base. Secure the post to the base by turning the post onto the captive grade-8 bolt inside the base plate.



**Step 4 & 5** As the roofers work their way up the roof slope, they will install roofing material around the posts and install the appropriate flashing. This is a common practice, and similar waterproof flashing will be installed around vent pipes and skylights.

### Step 6

An EPDM pipe collar is installed to waterproof the post-to-flashing connection. Once the roofers are done, you can continue with your PV installation, knowing that you're working on a warranted roof with code-compliant waterproof flashing and mounts.

