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## Tools & Techniques: Attaching solar on steep slope roofs

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Roofs over 2:12 pitch are considered steep slope and instead of using a waterproofing membrane like a low slope roof, they typically use water shedding roof coverings that rely on gravity to keep the water out of the structure. The significant majority of steep slope roofs use asphalt shingles or tile. The other common steep slope roof options include

wood shake, wood shingles, metal shingles, slate, standing seam metal roofs, or exposed fastener metal roofs. There are a variety of roof attachments and flashing methods available for each roof type, and careful selection is needed to insure you are able to deliver a structurally sound, waterproof, code compliant solar attachment system.

### Waterproofing basics

Building codes require that roof penetrations be flashed per the roofing manufacturer installation instructions. A significant majority of asphalt shingle manufacturers follow the National Roofing Contractors Association guidelines for penetration flashing which mandate metal flashing for all penetrations and specify the upper edge of the flashing must reach up into the third course of shingles. The vast majority of tile roof manufacturers follow the Tile Roofing Institute's installation guidelines that requires metal flashing to be installed at the underlayment level and sealed using bibbing or three coursing with roofing cement and reinforcing fabric.

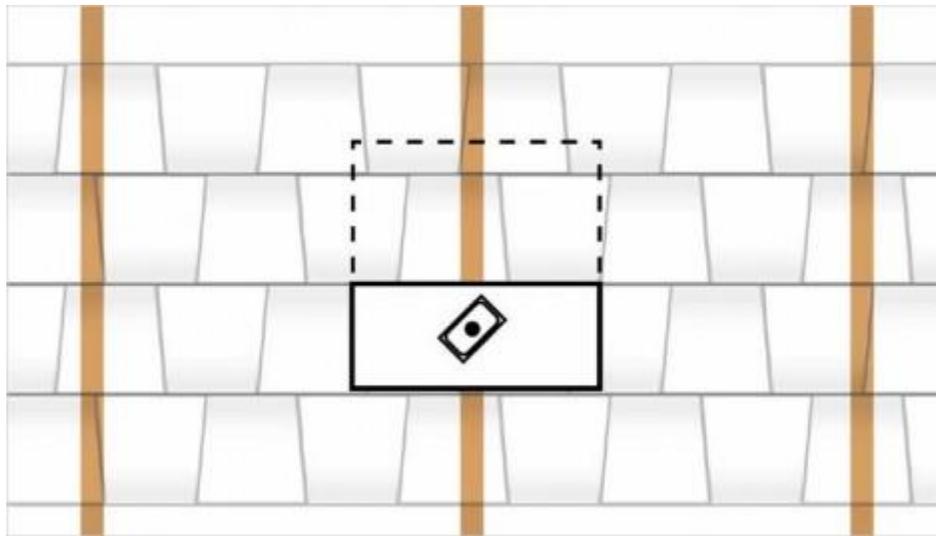
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## Structural attachment method

Rafter attached systems have been the norm for solar installations as the tried and true attachment method. Building officials allow rafter attachment as long as the roof meets established criteria. An alternate attachment method secures the racking system directly to the roof sheathing. Using sheathing attached systems may be inadvisable since it can be difficult to verify whether the sheathing is reliably secured to the rafters. As a result sheathing attached systems are often not allowed on existing roofs in many jurisdictions. Sheathing attached systems can work well for new or re-roofs applications since the installer and building official can verify that the sheathing is attached to the rafters before the roof covering is installed.

If a sheathing attached system is used on a new roof, it's important that point loading on a single attachment does not get concentrated on a single fastener. This could initiate a structural problem if the fastener pulls out under dynamic uplift forces from windstorms.



*This flashed roof attachment is rafter mounted and provides a reliable structural attachment for full code compliance*

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## Shingle roof attachment

Options for shingle roof attachments include standoff cone flashings, hooded flashings, and integrated seal flashings. Standoff cone flashing use a metal cone flashing that elevates the seal area above the roof plane. Hooded flashings are inexpensive, but have a major vulnerability as they have an opening on the downhill side of the attachment, which can allow wind driven rain to access the penetration. Integrated seal flashings use rubber seals and can be very effective.

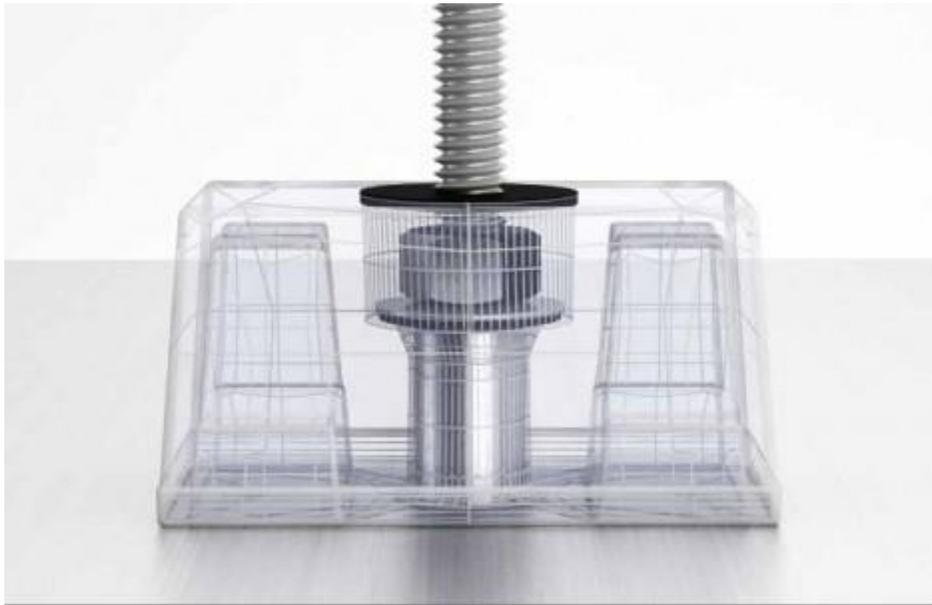
Seals located at the waterline will degrade more quickly than elevated seals particularly in cold climates where freezing water can wear out a rubber seal.



*Metal cone flashing provides ample elevation of the seal above the waterline, assuring longer seal life.*

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*The patented QBlock waterproofing system elevates the seal of this integrated flashed attachment 0.7" above the waterline. This approach positions the sealing area in a protective cavity shielding the seal from moisture and UV exposure.*

### **Tile roof attachment**

Options for tile roof attachment have expanded dramatically in the past several years and fall into three general categories: standoffs, tile hooks, and threaded bolts. Regardless of which method you choose, flashing at the deck level (underlayment level) is code required by the Tile Roofing Institute. Underlayment flashing can be challenging for certain tile attachments including the sliding track style base mount, but fortunately a growing number of code compliant tile roof attachments include preformed metal flashings to seal the penetrations at the underlayment level.

This code compliant tile hook (pictured at top) is quicker to install and has no visible flashing. The standoff on the right is super strong and uses a malleable tile level flashing. Both roof attachments are sold with deck-level flashing that are sealed to the underlayment under the tile.

### **Tile standoffs**

Tile standoffs are much stronger than hanger bolts as they have a larger diameter base and post, but both standoffs and hanger bolts require double flashing since the tile must be penetrated to allow for installation. The tile level flashing can be

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installed above or below the tile that is penetrated and the secondary flashing at the underlayment level would be sealed to the underlayment using bibbing or three coursing with roofing cement and reinforcing fabric. For curved tile, the TRI requires a malleable metal flashing molded to the tile.

## Tile hooks

Tile hooks typically do not penetrate the top of the tile, instead they protrude between 2 rows of tiles. The tile lug will need to be trimmed using a tuck pointing diamond blade to allow for clearance of the hook and insure proper tile seating. Some metal strap style tile hooks allow the weight of the array to rest on top of the tile. This method of attachment is inadvisable, as the array will vibrate on the tile in a windstorm, increasing the likelihood of broken tile. The best tile hooks provide a strong mounting location that elevates the hook and racking system off the tile— preventing contact with the tile under full wind loading conditions.



*To be code compliant, tile hooks must have metal flashing installed using Tile Roofing Institute approved underlayment bibbing (shown on the left). Three coursing with roofing cement and reinforcing fabric (shown on right).*

## Less common roof types

Asphalt shingle roofs and tile roofs represent over 90% of all solar installations in the US, but many solar installers are confronted with less common roofs like wood shake/shingle, slate, or metal shingle. These roof types are often found on more expensive homes and are more challenging for the installer. The benefits of learning how to work on these upscale roof types are fewer competitors and better profit margins.

Typically partnering with an experienced qualified roofer is advisable. Metal panel roofs are common in rural areas but exposed fastener roofs (corrugated or

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trapezoidal) may be less desirable than standing seam roofs as the fasteners often require periodic tightening and access to these fasteners is difficult after a solar installation. Standing seam roof rack systems typically attach to clamps on the standing seams. Standing seam panels are held on with clips, so the installer and building official should verify there are sufficient clips securing the roofing system, so it can withstand the uplift forces from the solar array when subject to strong winds.



*This home with [Decra](#) metal shingles in Florida uses standoffs with flashing installed with a Decra “Underpan” to channel any leakage safely to the top of the shingles below.*

As flashed roof attachment options continue to expand, it’s important to verify your your attachment of choice will provide a reliable, long-term, structurally robust and waterproof system for the life of the roof and array. Your customers will thank you.

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