

Mounts for Solar Collectors

OPTIONS FOR GROUND OR ROOF PLACEMENT



by Chuck Marken

Courtesy: Rushforth Solar

This site-fabricated mount-set uses few roof penetrations.

Solar thermal manufacturers usually supply the mounts along with their collectors, and factory solutions for mounting collectors definitely make a solar thermal installation easier. But if you install on a regular basis, you may find that making your own mounts is the way to go. Fabricating your own mount-sets is more time consuming but offers rewards in terms of cost and flexibility.

Mount Materials

Even if you plan to make your own mounts eventually, it is sensible to use racks from the collector manufacturer for the first few jobs. Once you have a good idea of how the factory sets go together, you can design your own. A compromise many installers make is to stick with factory sets for most of their jobs, stock extras of the parts that will put them in a bind if they come up short, and use the materials and techniques discussed here for those custom jobs that are bound to come up.

In my 30 years in the solar thermal business, I've seen collector mounts fabricated from recycled bed frames, lumber, steel wall studs, and electrical metallic conduit—but these materials are not the norm. A simple, durable mount-set can be built with pipe, angle, or square stock. Angle-iron (steel angle stock) is the choice of many installers because

of its low cost and ease of use in mounting systems. The common materials are steel, galvanized steel, stainless steel, and aluminum. All of these materials can make durable and strong collector mounts that will last for many decades. Here are some pros and cons of each.

A factory mount-set with a clip that slips into the collector extrusion to transition to Unistrut.



Chuck Marken



Although it's not pretty, this home-built mount-set has survived for more than two decades and still capably holds the collector.

Steel can be used in arid climates, since the possibility of galvanic corrosion between the steel mounts and aluminum collector frame is almost nil. In areas with higher humidity, steel stock will quickly rust and will require periodic maintenance, such as painting. The minimum dimension for $\frac{1}{8}$ -inch-thick angle iron or galvanized pipe is 1 inch. Smaller dimensions bend too much in long lengths.

Aluminum is a preferred material for its corrosion-resistance, and is the material of choice for racks and mounts in most of the solar industry. Aluminum extrusions come in a variety of different strengths and properties, and stronger aluminum is usually more brittle. Aluminum is not as strong as steel and needs to be a little larger-sized—the minimum dimension for $\frac{1}{8}$ -inch-thick extruded aluminum angle is $1\frac{1}{4}$ inches. While aluminum is lighter than steel, it's more expensive, harder to weld, and, unless it is anodized or powder-coated, has a brighter color than the collector frames, so it may stand out more.

Stainless steel (SS) comes in more than 100 grades, designated by numbers that relate to different amounts of alloys. The most common grade for use in collector mounts is 304, but it should not be used in marine environments, since it is vulnerable to chloride corrosion. Instead, 316, an alloy which contains molybdenum to prevent corrosion, is recommended for coastal areas. It is hard to drill and difficult to weld but provides

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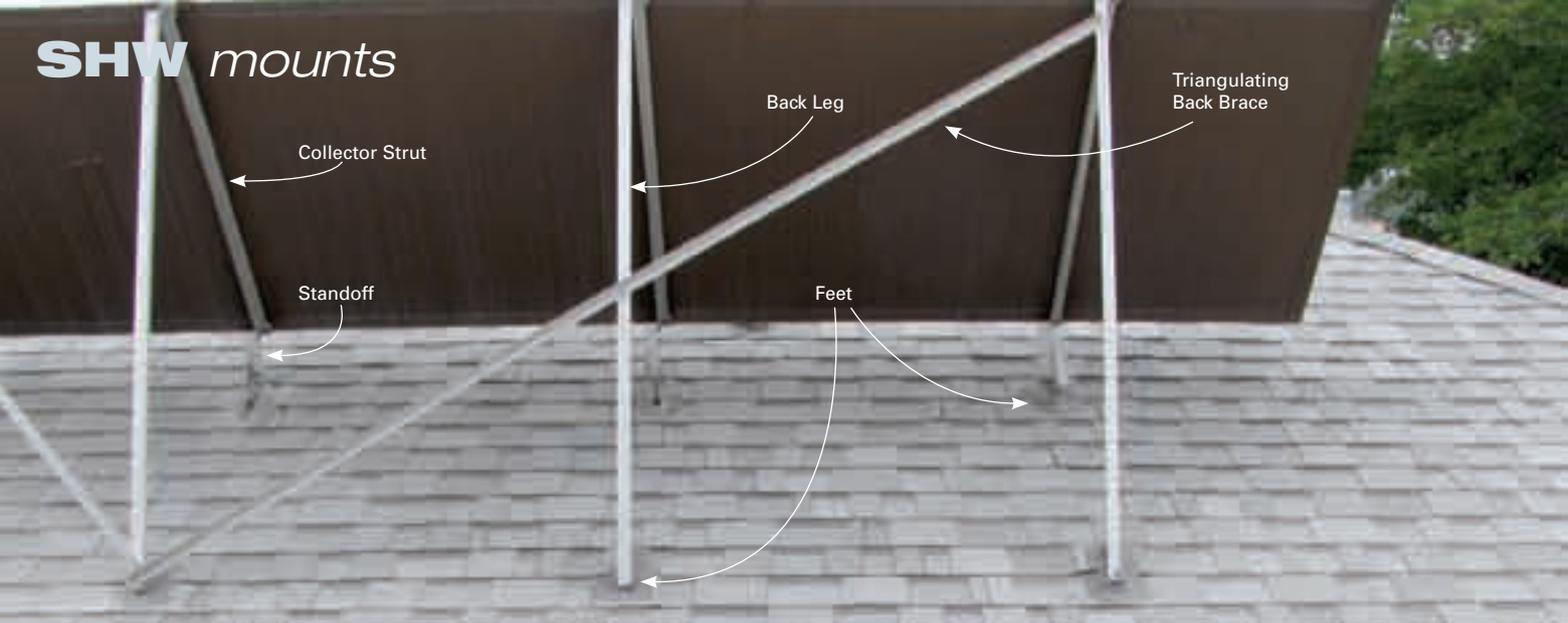
A pool heating system mounted on a site-built rack fabricated from steel studs.

excellent protection from the elements—it's the choice of boat builders for long-term saltwater exposure. If you're planning to weld stainless mounts, 316L (low-carbon) stainless is a bit easier to weld due to the reduced carbon content. The minimum dimension for $\frac{1}{8}$ -inch-thick SS angle is 1 inch. Stainless stock is similar in cost to aluminum, which has fluctuated in the past few years.

Steel construction studs, steel Unistrut (industrial metal framing), and galvanized steel are sometimes used instead of

A wall-mounted collector with a mount-set that is long on function, but short on aesthetic appeal.





The pieces of a homemade mount-set on the author's home.

aluminum. The material is stronger than aluminum, but can be more difficult to find. Unistrut is like a giant Erector set: it comes in a variety of angles and channels with holes. Braces, connectors, and slip-in threaded inserts (channel nuts) are available as well. It can be more expensive than other options, and is heavier and harder to cut than aluminum.

Lumber can be used to construct mounts, but it is not recommended. The ongoing maintenance (especially on roofs) is a hassle. Although using treated lumber can reduce the periodic maintenance, screwed connections are prone to weaken over time, and cracks and shrinkage can result in unreliable joints and roof penetrations. Using through-bolts will help strengthen connections to treated wood, and racks and sealed penetrations should be inspected occasionally.

Parts & Pieces

Hardware. Regardless of the mount material, stainless steel hardware (nuts, washers, and bolts) is typically supplied by rack manufacturers and is recommended for most climates. In arid climates, zinc-coated hardware may be acceptable.

These site-built mounts were made from angle stock with prestamped holes. In this case, a factory set would have been more attractive.



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Mounting Feet. The "mounting foot" is the part of a mount-set that is lag-screwed or through-bolted to the rafters of the roof (or other structure). Angle stock is a good material for feet since it can be drilled for bolting to the roof and the 90-degree face can be bolted to legs or struts. One or two holes are drilled into the foot for attaching to the roof structure. A typical single-collector mount-set of this type will have four feet held to the roof with four to eight lag screws or through-bolts. My company has installed thousands of collectors using plastic roof cement ("pookie") as the roof sealant. Care must be taken to put a bed of pookie under the foot, dip the lag bolt into the pookie prior to screwing it in, and cover the foot with a generous amount of roof cement as the last task before leaving the job. To keep roofing

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Wind Loading

Depending on where you live and what type of wind speeds your collectors will be exposed to, wind loading may or may not be an issue. Any side-to-side movement in the mount should be eliminated with additional triangulated support members, since any lateral play will allow strong winds to weaken the mount over time.

For collectors that aren't angled more than 4 feet above the roof, $\frac{3}{4}$ -inch angle iron or 1-inch aluminum angle have been used repeatedly without failure, since the wind loading is significantly less at lower tilt angles. Square stock and pipe may be used in the same dimensions for each respective material.

If building officials feel uncomfortable with a mounting system, they may require an engineer's stamp on the system drawing. Also, if you live in an area with high winds, having your mount engineered may save you some headaches down the road. Many collector manufacturers will be able to supply you with wind-loading calculations should they be required. For more information on wind and other loads, see "Dealing with the Forces of Nature" on page 77.

High Performance with Off-the-Shelf Parts

Tim Dawson and Luke Frazer of Solar Collection in Talent, Oregon, use off-the-shelf, 1-inch galvanized pipe for their collector mounts. Pipe flanges secure the mounts to the roof rafters or trusses and allow the penetrations to be flashed with ordinary Oatey roof jacks. They use tubular fittings to join the galvanized pipe, and U-bolts to interface with a short piece of aluminum angle that attaches to the collectors.

Here's an example of a neat installation with two Chromagen 4- by 8-foot collectors mounted with standoffs on a composition shingle roof. Note the position of the self-drilling screws attached into the collectors' frames. Whenever screwing into a collector, stay well away from the glass, since even catching an edge of the tempered-glass face with a screw will give you a bucketful of glass chips to clean up—and the expense of replacing the glass. Likewise, make sure that your hardware is not so long that it could penetrate the header pipe when screwing into the sides of the collector frame.

This design is suited for all roof types, ground mounts, and tilt racks. The mounting system can provide a level rack for antifreeze-based systems or a sloped rack for drainback systems (by using progressively shorter standoffs).



Courtesy Solar Collection, Inc. (5)



Flush or Rack Mounts?

Factory mount-sets come in two types: flush- or rack-mounted. Flush, or standoff, mounts are used to mount the collectors at the same pitch as the roof. A rack mount has precut or adjustable legs to tilt the collector at a steeper angle than the roof.

Both flush and rack mounts can be ordered for ground-mounted systems depending on the design and amount of standardized material used. If a ground mount has a structure built from angle, square, or round stock, a low-cost flush-mount kit can be used as an interface between the site-built mounts and the collectors. The flush-mount kits will likely include some sort of channel feet, with clips or mounts that attach to the collector. The channel feet can then be bolted or screwed to the site-built rack.



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A factory Novan roof mount-set with more than two decades of leak-free service—the sealant is plastic roof cement.

triangulated angle stock if needed. For a row of collectors, angle stock can be used as top and bottom rails bolted to the collector struts. This configuration makes a “lay-in” mount for a row of collectors, and each collector can be secured to the mounts with self-drilling screws into the collector’s top and bottom frame extrusions.

Access

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warranties intact, be sure that the sealant is made to work with the particular roof material.

Collector Struts. Once the feet are in place and spaced correctly, the collector strut and back leg of the mount-set can be bolted together.

There are many adaptations for constructing a basic mount-set. Mount-sets can also be strengthened using horizontal or

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