



Hot Sun Industries Inc  
 1440 N. Benson Ave. Suite D  
 Upland CA 91786  
 858-683-0800 e-mail: h2otsun@gmail.com  
<http://www.h2otsun.com>



## **GENERAL INSTALLATION MANUAL**

**see manual addendums for specific roof types**

© 2019 copyright Hot Sun Industries Inc (USA) and Hot Sun Industries Ltd (Canada)

Note: The OG400 standard for solar swimming pool heating requires that contractors install these systems to manufacturer's specifications. This manual constitutes that specification.

### **SUMMARY OF IMPORTANT NOTES:**

Ensure all piping slopes downhill to drain and all plumbing drains are left open through freezing conditions. Note: Solar heaters are solar coolers at night. Air temperature only has to drop to 42F for water to freeze inside a solar cooler. The flexible fin-tubing can freeze full of water without concern. Plumbing and header manifolds are not flexible and are vulnerable. Drains on flat rooftops should be closed once plumbing is emptied to prevent water getting back in and freezing. See repair manual if damage occurs.

Commission each installed system by checking start up pressure at typical vacuum breaker location. (less than 8psi) Check running pressure (less than 5 psi). Verify variable speed pump prime speed is turned down. Check pressure when pump runs through its starting cycle (less than 8psi). Verify vacuum breaker exhausts air fast enough to prevent fin tube collapse when solar turns off. If not add return line vacuum break. Verify all horizontal piping and manifolds are supported every 27 inches max. Verify free movement 1.5" each way for every 15 feet of straight pipe run. See START UP INSTRUCTIONS.

### **1.0 SAFETY:**

Don't attempt this installation if you are not fully capable of working safely on the roof or hillside or wherever you will be working. Falls from roofs are a common and serious workplace accident. The use of safety equipment including body harnesses, lanyards and lifelines, ladders, and hazardous chemicals require training and certification. Hot Sun will not be held accountable for injuries. We require that you take all responsibility for learning how to use and for using correctly all safety equipment and chemicals and tools. Read all warning labels on all adhesives and cements used in this installation. Wear gloves and safety glasses and don't work alone. The adhesive (CA) that joins the fin tubes to the headers emits fumes that will burn your eyes and it can stick your skin to itself or the materials being adhered. PVC cements contain methyl ethyl ketone, a known carcinogen. Primer is especially dangerous. Use a respirator in confined spaces. Wear eye protection.

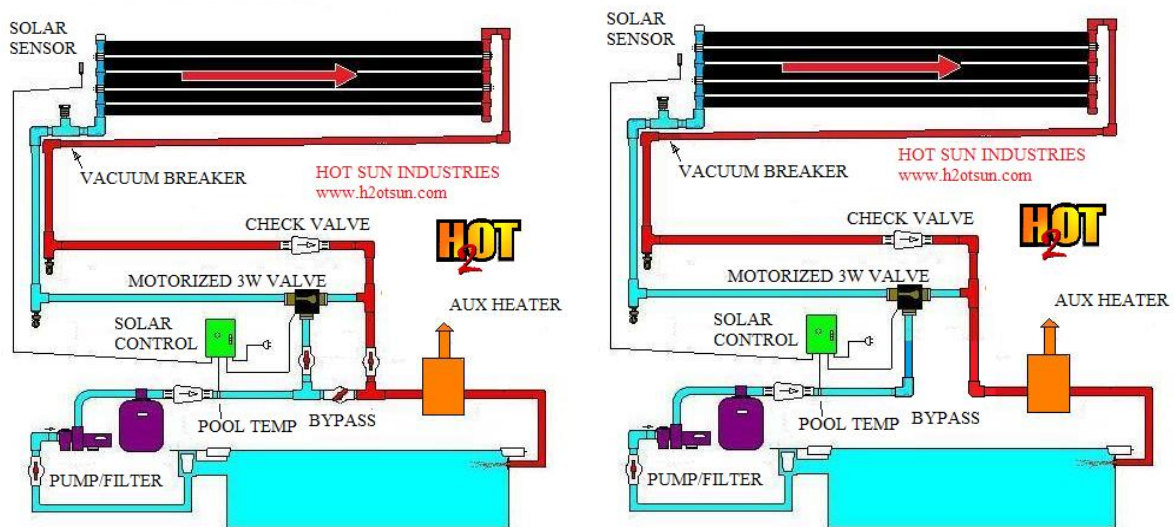
### **2.0 POOL SYSTEM COMPATIBILITY**

Before starting an installation you must ensure the pressure where solar ties in (right after the filter usually) is lower than the height of the roof where the solar collector will be located. This is seldom an issue with

pools that are filtered using variable speed pumps. Beware of in-floor cleaning systems or special cleaning systems that require extra pump speed. Beware of solar collectors located at or below pool level. If in doubt install a pressure gage at the solar tie in point and compare to roof height. 0.433 psi equals one foot of elevation difference. Turn down the variable speed pump's priming speed. The default is full speed which usually will result in too much filtration system pressure. Schedule higher speed functions like vacuuming outside the hours of solar operation.

### 3.0 THE TIE IN:

Our recommended typical solar tie in uses a 3 valve bypass arrangement as shown below left. The reason for this scheme is that it allows anyone to bypass and isolate the solar system from the pool system without having to get into the controls to turn the motorized solar valve. It also allows for easier winterizing. If the pool is in a non freeze zone and if solar and the the pool are not mismatched in size the diagram at the right can suffice. In this case use a top quality check valve because it is the only means of isolating solar so you can still run the pump if solar piping is damaged.



General Schematic of Solar Pool Heater

The diagram above show a typical plumbing scheme. When the roof (solar) sensor gets warmer than the pool temperature sensor (plumbed right after the check valve, CV1) and the pool is colder than the set point you've set on the controller (the maximum pool temperature), the motorized valve will turn and divert flow to the bottom of the bank of solar collectors. The water rises up (or sideways) through the collectors flushing all the air out to the return pipe and back to the pool. When solar turns off after the pool is warm or the solar day is over, the 3 way solar valve turns another 180 degrees so that flow does not go to solar.

The check valve CV1 prevents the water from going backwards through the filter and pump when the pump is turned off. Normally we'll put a clear swing check valve CV2 on the return from solar pipe just so you can see the flow. CV2 also isolates solar when solar is off. CV2 must be mounted with the flow sideways or up. If it mounted so the flow goes down, gravity will hold the flap open and it will not seal.

Note the bypass valve in Figure 1. It should always be assumed that we wouldn't be able to send all the flow from the pool pump through all the extra plumbing we add when we install a solar heater. The bypass controls how much goes to solar when solar is on. It's adjustment is explained below under "Start Up". Controlling solar panel pressure is NOT simply a matter of adjusting the bypass valve. In fact it has little to do with it. Bypassing some flow only eliminates the extra pressure caused by sending too much flow through

solar. Instead of the bypass valve the 3w valve can be plumbed directly as shown in the diagram to the right above and for the correct portion of flow to solar, cams inside the motor, (the 3 way valve actuator) can be adjusted.

If the solar heater is to be manually controlled (saving the cost of the automatic controls) the plumbing scheme will usually be identical except that the motorized valve will not be motorized

## 4.0 CONTROLS

Pool automation systems usually include the brain for solar. In these cases the pool temperature sensor is already in place. All you have to do is plug the actuator (the motor of the motorized valve) into the control panel as well as the wire from the solar sensor. Hot Sun solar sensors are made of a piece of solar panel material to perfectly mimic the temperature the solar panel would be if there was no water flowing through it. Locate the solar sensor in the same sun (shading angle direction) as the solar collector. Note this does not necessarily have to be on the roof next to the solar collector. The wire to the solar sensor can be a direct burial outdoor rated 18 GA wire or it can be inside a conduit. Secure the wire with UV rated black cable ties. Solder and heat shrink the connections. Hot Sun supplies these sensors with any wire length pre-attached.



Hot Sun solar sensor. Don't attach to pipe or solar panel.

Stand alone differential thermostats can be used if the pool automation does not have the solar feature built in. Differential thermostats compare the solar sensor temperature to the pool temperature sensor and the maximum pool temperature setpoint, turning the motorized valve to solar on or off accordingly.

## 5.0 INITIAL SYSTEM START-UP (COMMISSIONING)

**It is very important to check system pressures on a new solar heater.** Start with BV1 fully open. Close the drains, open the 2 isolation valves (BV2 and BV3) fully and turn the 3-way valve to direct flow to the solar panels. Slowly close the bypass valve BV1 until the air flushes out of the solar panels and into the pool dramatically. The filter pressure will rise as the air flushes through and then settle back to a new lower level. Close BV1 further until you just start to see the pressure gage on the filter start to react. We want as much flow as possible without adding extra pressure. You can feel the solar panels when operating in Hot Sun. They should feel pool temp, not hot, and there shouldn't be any hot spots.

If this is the first time the system is started up you should install a pressure gauge on the roof at the level of the solar panels roughly (tee in a pressure gauge on the feed pipe into the solar panels) and check that there isn't any pressure in the solar panels when solar is off (but pump on). An easy way is to use the threaded

hole for the vacuum breaker. Then turn solar on and verify the pressure is no more than 5 psi when solar is operating. Do the checks and then replace the vacuum breaker right away. **Do not purposely add pressure.** All you need is less than 1/10 psi to drive more than enough flow through solar. Contact us if there is a pressure situation. Watch the pressure spike as solar turns on and record how much. If it spikes to more than 8 psi it's too much. Contact Hot Sun. **The lower the pressure on the solar panels the better.** Note that if the vacuum breaker is sucking air, you can increase the flow. Close BV1 further but not so far that you add pressure. Make sure the normal operating pressure is less than 5 psi.

You can also control that bypass flow by setting cams on the motorized valve. Some installers prefer this method as it makes the plumbing easier and with variable speed pump running at low speed often we are sending all the flow to solar anyway.

Check vacuum breaker operation. Run solar and then turn the solar valve to solar off. Inspect the fin tubing to make sure it has not collapsed. If it has the system needs an additional vacuum break. One will have to be added on the return side. The feed side vacuum breaker can usually be moved to the return side to resolve this issue. Then you have to check to make sure the vacuum breaker isn't opening constantly drawing air into the pool. Speed up the flow, use more restrictive return line piping, incorporate some bends in the return piping or add a restricted ball valve to get the vacuum breaker pressure above zero. Vacuum breaker location with respect to return line elevations and plumbing characteristics can be a bit of an art form. Let Hot Sun help. Designing a solar heater to operate "smoothly" means minimal effect on the pool filtration and minimal pressure changes positive or negative as the system operates automatically through time.

Over a design 160 degree temperature swing 20F to 180F manifolds and pvc plumbing will change length by 3 inches over 15 feet. Make sure the plumbing can move freely enough to accommodate this kind of movement. Its huge. More than you would assume.

#### Commissioning Checklist

Max start up pressure less than 8 at feed side vacuum breaker location.

Normal operating pressure less than 5psi

Pump priming solar pressure less than 8 psi

Solar off pressure not negative (fin tubes are not collapsed).

Horizontal plumbing supported every 27 inches

All manifolds secured at ends and every 2 manifolds (27")

All piping and manifolds can move 1.5 inches for every 15 foot plumbing run. Pay attention to corners.

Paint all plumbing and pipe connections. UV will go through white PVC and attack glue joints.

## 6.0 PLANNING THE JOB

The fin tubing comes in rolls that are 88 feet long. Each strip is 6 tubes wide and measures 3.75 inches wide. Three of these strips go on each 13.5" long header manifold. The headers take up 13.5" when alternating (one row of headers at each end with gaps between the one foot nominal fin tube sections) The Powerstrip fin tubes take up 11.25" when closely packed in a staggered configuration (two rows of manifolds at each end) . We want to make lengths that don't leave us with scrap so work with lengths of 1/3 roll (29'4") or 1/2 roll (44 feet) or 1/4 roll (22 feet) or 1/5 roll (18 feet). These and shorter are your target lengths. Custom lengths like 50' can be supplied at a 10% premium.

## 7.0 INSTALLATION

### 7.1 ASSEMBLING MANIFOLDS TO FIN TUBING:



Refer to the specific installation manual addendum for your roof type.

Use the supplied CA adhesive to connect the flexible solar tubing to the nipples on the header pipes. Start by stripping the 3.75" wide strip of tubing into two tube wide strips so you can glue 2 tubes at a time. Not over the whole length - just strip about eight inches.



Start by cutting the fin tubing squarely with an anvil style cutter (Hot Sun can supply). Be careful not to nick the fin tubing. Simply apply the CA adhesive to the nipples all 18 at a time unless its really windy. Fully wet the entire surface of each nipple all the way around and then slide the tubing on two tubes at a time.. Wear gloves and be careful you don't glue yourself to the header. Read the warnings on the 4 oz bottle of special adhesive.

Make sure the entire nipple surface area is fully wetted before sliding the tubing on. Use the supplied smaller bottle and applicator (dauber) brush. One dip of this brush fully into the bottle (note the depth it dips is adjustable) is the right amount of adhesive for all 18 nipples on one header manifold. If the CA adhesive skins over or dries, reapply. Always wear eye protection and gloves.



Pushing fin-tubing onto header 2 tubes at a time.



CA adhesive

Work outdoors and keep your face upwind of the wet adhesive. The fumes sting your eyes. Eye protection is very helpful at keeping the fumes off your eyeballs. Push the tubing on 2 tubes at a time without hesitating because as soon as static contact is made, the bond occurs. Only apply the special adhesive to the nipple, not the inside of the fin tubing. The bond is instant when the CA bottle is fresh. Once its been exposed to air for a minute or two the adhesive is a lot easier to use. An aged bottle off gasses a lot less too however there is a short shelf life so keep it refrigerated and read the label.

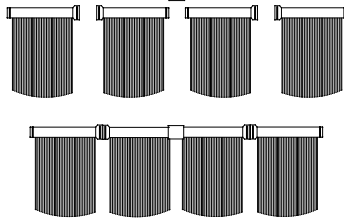
Always glue the manifolds to the fin tubes before attaching the manifolds to each other or mounting them., Start at one side and finish that side. Straighten it out and then use a chalk line to mark the opposite end. Then cut to length and attach the opposite end's header manifolds. Don't assemble all the manifolds together first and then try to glue the fin tubes on. That's a common mistake. Once you glue a pvc coupling to the male end of a manifold its tough to glue the fin tubing onto that last nipple. Also you need to handle the manifold to see that you've fully wetted the nipples with the CA adhesive. Its very important you don't miss a spot. The seal requires the CA makes the seal. Its not just a stretch fit.

Assemble manifolds to fin tubing before plumbing headers or securing headers to roof.

## 7.2 ALTERNATING OR STAGGERED HEADERS

Alternating means we alternate the direction each manifold faces using a rubber removable coupling or glue on pvc coupling on the male to male manifold connections and a 2" long stub of 1.5" PVC pipe glued between the female ends.

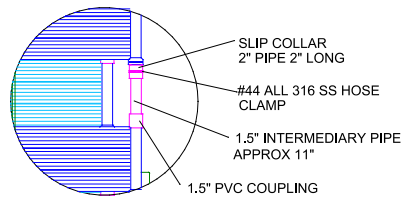
ALTERNATING MANIFOLDS - MALE TO MALE VIA PVC COUPLING  
FEMALE TO FEMALE VIA PIPE STUB



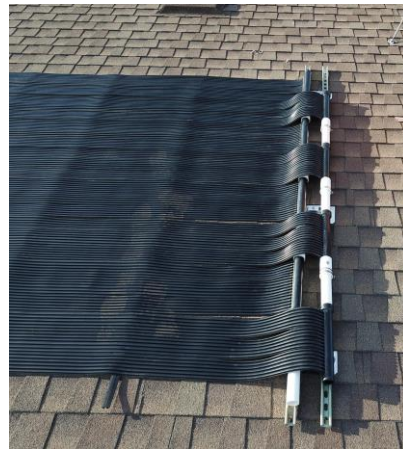
When we alternate the headers we are using a single row of manifolds. We create a space between fin tube sets ( each fin tube is 6 tubes 3.75" wide. 3 of these per manifold is a set). The space allows for air pressure release and sometimes it is advantageous to also allow the roof to breathe.



Removable rubber coupling for male to male manifold connections or PVC glue on coupling



STAGGERED MANIFOLDS



When we stagger the manifolds we are splitting the flow up between two 1.5" manifold assemblies. We eliminate the spaces between the fin tubes. We often do this when running the fin tubes sideways as shown above. Its easier to arrange all the fin tubing when one strip sits directly next to its neighbor.



Staggered headers with pvc pipe on a rack installation



Fin tubing cut before staggered headers attached

Staggered (shown above) means all the headers face the same direction. Staggering involves two rows of headers eliminating all the spaces between the one foot wide sections. Staggering allows the 9-5/8" long pieces of pvc pipe spanning between headers to be used to positively secure the system to the roof while allowing full movement of the header manifolds as they expand and contract with temperature change.

That pipe between adjacent headers is not clamped to the roof. Its inside a short 2" sleeve of pvc pipe that is clamped to the roof. The "slip collar" elevates the pipe and the manifolds and allows free movement as the plumbing and headers expand and contract with temperature. Note the manual addendum specific to your roof type will detail specific mounting methodologies often involving the use of structural steel members made of P4100 slotted shallow unistrut. Always keep in mind manifolds and pvc pipe need to be able to move 3" over 15 feet. That's 6 inches of movement over 30 feet. Keeping that in mind is the key to a successful solar plumbing job.

## 7.3 SIDEWAYS vs CONVENTIONAL

### 7.3.1 CONVENTIONAL

Conventional means the flow of water goes up the roof. Water enters at one bottom corner and exits diagonally opposite at the top.

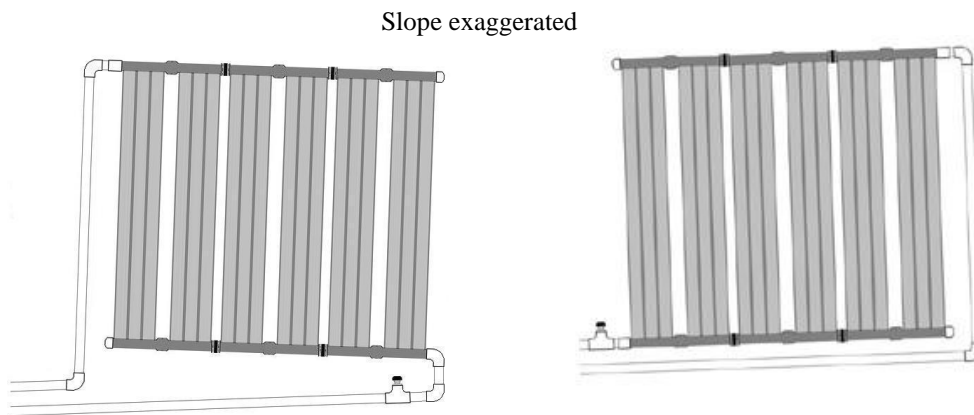


Fig. 2: Sloping panel banks and roof piping

In conventional orientation you have to provide a tilt to the top headers so the air doesn't get trapped. A corresponding slope on the bottom headers ensures the bottom headers drain.

Note that with Powerstrips we secure the bottom and the top manifolds. With other collector types you have to allow the bottom header to float as the entire collector length must be free to change length with temperature. Not so with flexible Powerstrips. The stress that they pull with when contracting is far less than with other collector types. This is a huge advantage because this provides a great deal of wind resistance.

We might choose to stagger the headers if the fin tubes will be relatively long to make better use of available space. Staggering on sideways configurations makes it much easier to arrange the fin tubes because there are no gaps. Near the ocean in some cases we will want to take advantage of the gaps that alternating orientation provides in order to ventilate the roof to avoid the growth of lichen if this is a problem in the coastal area in question.

### 7.3.2 SIDEWAYS

Sideways orientation means the flow is right to left or left to right. This orientation does not have to be tilted (like it does with conventional mounting (Fig 2) because there is no air entrapment potential. The

header manifolds run up the slope and the fin tubes are horizontal. We can do this with Powerstrips because they are flexible. You don't have to get the water out of them for freeze tolerance. They can expand. Generally speaking you want the headers to be on the shorter dimension and the fin tubing to run the longer roof dimension. This makes for the easiest and most cost effective installation with the fewest roof penetrations and best aesthetics.



Sideways with alternating headers



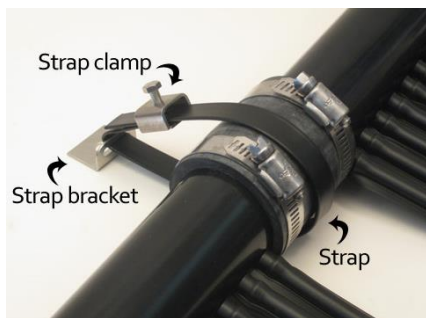
Sideways with staggered headers

Refer to the appropriate manual addendums for your roof type at [www.h2otsun.com/manuals.html](http://www.h2otsun.com/manuals.html)

## 7.4 COLLECTOR MOUNTINGS

Refer to manual addendums for each roof mounting type. On flat roofs we employ a ballasted system so there are no roof penetrations. On tile roofs we employ an all adhesive mounting so there are no roof penetrations. On a ground mount we usually build a bed of gravel and install a ballasted flat roof system on that. On a shingle roof we must penetrate the roof because the surface of the shingle has no strength

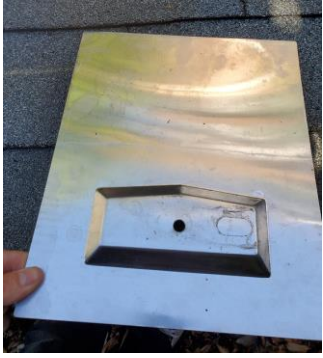
Our standard toolkit includes vinyl coated stainless steel strapping, strap brackets, strap clamps, plus proper flashed roof brackets all manufactured and supplied by Hot Sun.



Standard hardware



Roof bracket



Flashing



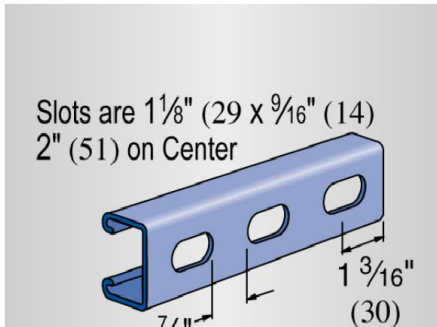
Unistrut



Hose clamp slider

Four #10 stainless steel screws grab the roof sheathing under the shingles. We don't need to hit the rafters. We start with the idea that we want a proper secure flashed roof connection every 6 feet very similar to what we see with a PV system (photovoltaic solar electric). The idea is to grab the sheathing anywhere near the rafter. These proper flashed roof connections can be used to support off-the-shelf shallow slotted Unistrut.

**P4100T - 1-5/8" x 13/16" , 14 Gage, Slott**



Unistrut



PL roof and flashing sealant

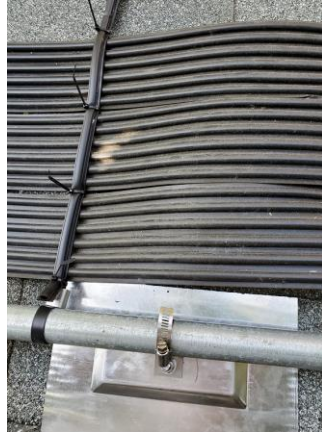
-  
Seal any roof penetrations and where threaded studs come through flashings with black polyurethane roof and flashing sealant as shown above

Hose clamp sliders secure manifolds directly to Unistrut allowing full movement as manifolds expand and contract with temperature....6 inches over a 30' run! Hose clamp sliders on Unistrut are a great way to securely fasten plumbing to the roof as well.

A strap bracket can be secured to the roof properly with the above flashed roof brackets. The strap bracket can be used to secure a strap or a piece of chain link fence top rail (top rail). Top rail can be used to create a framework to support the fin tubes and to minimize the roof connections.



Chain link fence top rail

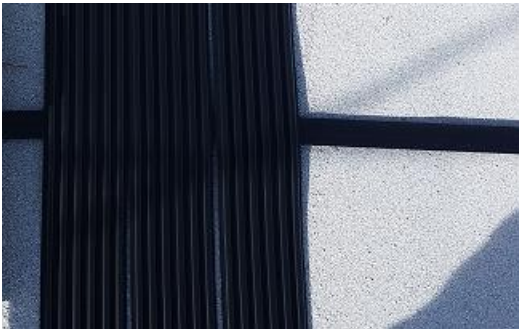


strapping fin tubes

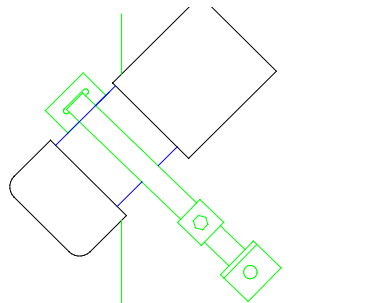
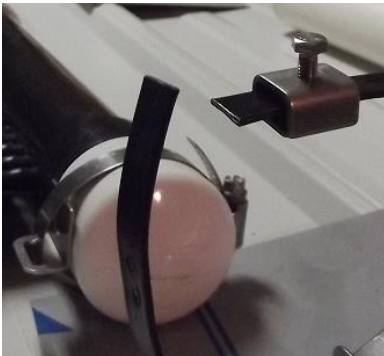


PL construction mastic

When using the vinyl coated ss strap to strap down the fin tubes we run the strapping under the fin tubes. This is a lot easier than going over because it can be done before the fin tubes are laid out. The vinyl coated ss strap is compatible with both the CA adhesive (for tacking) and Loctite or Lepage's PL 3x construction mastic (PL) shown above. We can glue the fin tubes to the strap using PL. Note PL construction mastic is an adhesive. Roof and flashing sealant is a sealant. It will damage the fin tubing. It is for sealing roof connections and flashings. PL is for gluing fin tubes to vinyl coated strap, glue strip, metal and tile. When strapping fin tubes with the strap under the fin tubes we can either glue the fin tubes to the strapping by tacking with CA and/or gluing with PL. Use the 12 oz cartridge size not the large size to avoid run out between applications. Alternatively we use a one tube wide piece of the fin tubing over the top and then sandwich the fin tubes to the strapping every strip (3.75" wide) using UV rated black nylon zip ties. This method allows room for error. You can adjust positions of fin tubes.



Glue strips are 2 tube wide pieces of our fin tubing material placed under the system in advance. The fin tubes are glued (PL) to the glue strip as the last step. Glue strips serve the purpose of keeping the fin tubes arranged over time. Glue strips are placed tube side down.

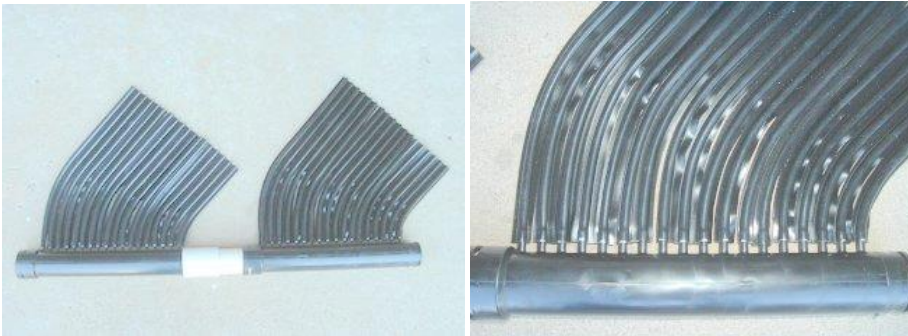


An useful trick to keep a strap from coming off or cutting into adjacent fin tubes as the manifolds change length with temperature is to loop the strap through a strap bracket that is hose clamped to the manifold or end cap.

## 7.5 ANGLED MANIFOLDS



Manifolds can be angled to match the roof space.



Normally angled headers are used on left side, right side or bottom, but seldom on top manifolds. The fin tubes are separated into individual tubes and glued on (CA) one at a time. Angled headers are seldom staggered because you can eliminate the spaces between adjacent Powerstrips without having to stagger headers. In fact you will usually use glue on couplings male to male ends and space the female ends apart to match fin tube positions. These photos show male end glued to pvc coupling glued to pvc pipe glued to female end and so on. Many variations are possible.

## 7.6 GOING AROUND CORNERS

You can "strip" the tubing so the web of 6 tubes is 1 or 2 or 3 tubes where it goes around the corner. Test what works for your angles. You don't want to make roof connections in roof valleys where there is a lot of runoff so being able to continue the flow through the flexible Powerstrips without stopping can be very advantageous.



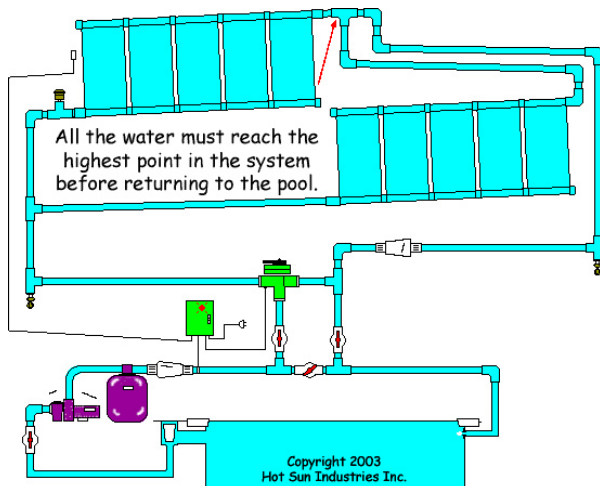
Test it out before you commit. It depends on roof pitch and angles and visibility. Sometimes you can just take the corner without adjusting the fin tubes at all. Often separating into 3 tube wide strips just at the corners is workable. It all depends on the slopes and angles and the visibility from ground level

## 8.0 PLUMBING



Glue connections are done using P70 primer and 2711 heavy body PVC cement. Don't use primer on the manifold itself. The manifolds are not PVC. They are a styrene material which reacts more aggressively with the active ingredient in PVC cement and primer, MEK. Fully wet the inside of the fitting and the outside of the pipe using the daubers inside the cans. Check to make sure you don't miss a spot and make sure everything is dry first. Twist 1/4 turn as you assemble and wipe off excess. Paint all connections after the glue has dried. UV will go right thru white PVC and attack the glue joints. Take the sharp edge off the end of a cut piece of PVC pipe before gluing. Let the glue dry 24 hrs before sealing the system up. Let it breathe with the drains open and the vacuum breaker removed.

All horizontal plumbing should be support every 27". Bends at the ends of long runs of pvc pipe should be done with several feet of flexible pvc spa pipe. Glue couplings on the ends of the flex pipe (P70 primer and 2711 heavy body grey PVC cement) and let these connections fully cure before installing the bend. The flex pipe needs to not be stressed as it dries because...it can flex inside the joint.



In order to flush all the air out it must be allowed to rise to the highest point in the system as shown in the diagram below.

Figure 13: Typical Multiple Panel Bank Assembly

Do not use removable couplings on pvc pipe. PVC can't take the stress and the heat combined. If you use removable couplings on the male to male manifold connections do not overtighten. Once complete and operational lift the rubber off the manifold with a screwdriver and squirt some CA adhesive between the rubber and the manifold. Do this at several places around the circumference. This will prevent the rubber slipping off the manifold yet you'll still easily be able to disassemble it at the cost of the rubber but not the manifold

We recommend a slope of at least 1 to 120 (1" in 10' or 8mm in 1m) for horizontal manifolds and plumbing piping and that all piping be painted where exposed to sun. Paint the exposed side of the pipe after installation with gloss black paint, not from a spray can. Acrylic paint works best with pvc. Use a brush and small roller. Slide a piece of cardboard between the pipe and the roof as you go. Painting is best done before the piping is attached to the roof but after its plumbed in. Gloss black resists fading better. Black paint allows the piping to collect solar energy. Piping on the side of the house can be painted to match the house. Keep the pipes next to each other for a neat appearance.

You need to be able to drain water from the piping and header pipes at any low points to prevent damage from freezing (assuming you are in a climate where it does freeze). Slope all the plumbing down to these drains.



Install the vacuum breaker on the free low corner of the bank of solar panels or preferably on the pipe entering the solar panels. If there is more than one bank of panels the vacuum breaker should be on the bank of panels that is highest on the roof

The vacuum breaker lets air in when the pressure goes below zero to prevent plumbing and solar panels from collapsing. It doesn't vent air or release pressure. The solar system is open to the pool. Air flushes to the pool upon start up.

Install 1-1/2" PVC end caps or drain points as needed on the remaining corner(s)

All piping is schedule 40. Horizontal runs of piping along a wall should be supported every 4' (1.2m) according to code but this can get hot so we recommend a spacing of 27" for pipe supports especially on the roof. Underground piping can be buried deep enough that it can stay full of water all winter. Check with a plumber or city hall for the depth required in your area. Alternatively underground piping can be shallow and sloped one way or the other to a drain. A drain pit can be constructed where a large hole is dug (about a foot deeper than the piping), partially filled with gravel. If you bury the pipe below the frost level you can get away with drains at ground level where the pipes come up. There will be a small column of water that will freeze but it can expand up the pipe.



Remember pvc pipe needs to be able to change length with temperature. A piece of 2" pvc pipe fits over 1.5" perfectly allowing the 1.5" to slide freely while the 2" collar is secured positively.

All Hot Sun hose clamps used are all 316 stainless steel. Normal hose clamps will rust over time.

## 9.0 TROUBLESHOOTING and REPAIR

### Air Bubbles:

You should see a big flush of air when the solar heater starts up in the morning. It should stop after a few minutes. If air is entering the pool inlets constantly after the system has started up then the vacuum breaker is probably opening and allowing air to enter. Go on the roof and listen to it. You will hear air entering the vacuum breaker if it is the source of the air. If it isn't, then you have a leak on the pool plumbing before the pump or near the top of the solar panels. Check the pump lid seal. The vacuum breaker is mounted to the bottom header of the bank of solar panels to try and keep some pressure on it so it stays closed. One remedy is to just live with some air bubbles. Another remedy is to increase the pump speed (assuming variable speed). Perhaps the filter just needs to be cleaned or backwashed. Yes, that's right. Your filter needs to be cleaned. That's why the vacuum breaker started sucking air. You can increase the flow thru the collectors if BV1 isn't closed all the way already. Close it until you see the pressure gage on the filter react. Closing BV1 to send more flow to solar is the same effect as increasing the pump speed but we try to avoid having to do anything different for solar. Your pump speed is set for filtering and unless it is set pointlessly too low you shouldn't have to change it to accommodate solar.

### Poor performance:

If you suspect the system is not heating as well as it should be, check the solar panels on a sunny day. When operating (water flowing through them) solar panels will be cool to the touch across their entire width. Near the bottom of the collector (or feed side) the collector will be close to the swimming pool temperature. Near the top of the collector the temperature will be a little higher (depends on flow rate) but for efficient operation will only be about 5-10 degrees F higher than pool temperature at solar noon. If there is a hot spot, then water is not flowing through this area. Make sure the panels are draining down some when solar shuts down to ensure you aren't losing heat at night.. Without turning the pump off, turn solar off, wait, then on again and make sure you see air bubbles flushing into the pool. This confirms the panels drained down when off. If they don't drain down you could be losing heat if the pump is on at night due to an induced backwards cooling circulation.

**SERVICE:** You can splice the tubing with 1/4" pvc drip irrigation – see repair manual. Beware of polypropylene drip irrigation tubing. Make sure its pvc which is the same as "vinyl". You can always test it by seeing if it glues to itself with the CA adhesive. Gorilla brand superglue- see repair manual (under manuals at [www.h2otsun.com](http://www.h2otsun.com)) is an alternative to buying the CA from Hot Sun . If you have a leak, seal the vacuum breaker location with a plug, run solar, then shut off the pump. Air will be drawn in at the leak location. You can use this method to get 2711 pvc cement to flow into the joint.

Auto Controls: If its not coming on or off automatically the first thing to do is check to make sure the little switch on the actuator is set correctly. It is a 3 position switch. In one position the system operates in reverse so if you change it make sure you remember which position is correct. The middle position

prevents the actuator from turning. You can also check the sensors. The two sensors (one on the roof and one in the pool plumbing) are 10,000 ohm thermistors. They measure 10,000 ohms at room temperature. Lower when hotter, higher when colder. If solar isn't coming on when it should, short out the roof sensor at the control panel . If that makes solar turn on then it's a broken wire to the roof sensor or a bad roof sensor. If that doesn't work disconnect the pool temp sensor. If solar comes on then it's the pool temp sensor. Parts for these control systems are universal and available worldwide. The motorized valves are pool industry standard parts. Any pool service man has access to all the parts through his local pool equipment distributor.

### **BROKEN HEADERS**

To replace a manifold it is important to understand that the fin tubing can be cut short and stretched. It will become the new length over time. The fin tubes are plastic not rubber. The word plastic means it deforms plastically to become the new size. The female ends of the manifolds are 2" standard pipe size on the outside. They can be cut at this point with a hacksaw and remade using a 2" mechanical joint coupling. The grooves on the manifold match. 2" MJ couplings are a standard universal plumbing part



Addendum manuals covering all the specifics of collector mounting on all the different mounting surfaces are under "MANUALS" at [www.h2otsun.com](http://www.h2otsun.com)



Hot Sun Industries Inc  
 1440 N. Benson Ave. Suite D  
 Upland CA 91786  
 858-683-0800 e-mail: h2otsun@gmail.com  
<http://www.h2otsun.com>

## *Hot Sun Solar Pool Heaters*

# **GENERAL INSTALLATION MANUAL**

**see manual addendums for specific roof types**

© 2023 copyright Hot Sun Industries Inc (USA) and Hot Sun Industries Ltd (Canada)

## **SUMMARY OF IMPORTANT NOTES:**

Ensure all piping slopes downhill to drain and all plumbing drains are left open through freezing conditions. Note: Solar heaters are solar coolers at night. Air temperature only has to drop to 42F for water to freeze inside a solar cooler. The flexible fin-tubing can freeze full of water without concern. Plumbing and manifolds are not flexible and are vulnerable. Drains on flat rooftops should be closed once plumbing is emptied to prevent water getting back in and freezing. See repair manual if damage occurs.

Commission each installed system by checking start up pressure at typical vacuum breaker location. (less than 8psi) Check running pressure (less than 5 psi). Verify variable speed pump prime speed is turned down. Check pressure when pump runs through its starting cycle (less than 8psi). Verify vacuum breaker exhausts air fast enough to prevent fin tube collapse when solar turns off. If not add return line vacuum break. Verify all horizontal piping is supported every 36" inches max.

## **1.0 SAFETY:**

Don't attempt this installation if you are not fully capable of working safely on the roof or hillside or wherever you will be working. Falls from roofs are a common and serious workplace accident. The use of safety equipment including body harnesses, lanyards and lifelines, ladders, and hazardous chemicals require training and certification. Hot Sun will not be held accountable for injuries. We require that you take all responsibility for learning how to use and for using correctly all safety equipment and chemicals and tools. Read all warning labels on all adhesives and cements used in this installation. Wear gloves and safety glasses and don't work alone. PVC cements contain methyl ethyl ketone, a known carcinogen. Primer is especially dangerous. Use a respirator in confined spaces. Wear eye protection.

The rails used and the pvc piping can roll if you step on them. The same is true of pvc collars. This presents a safety hazard on a roof. Organize things carefully and bring these materials to the roof only as they are installed if possible.

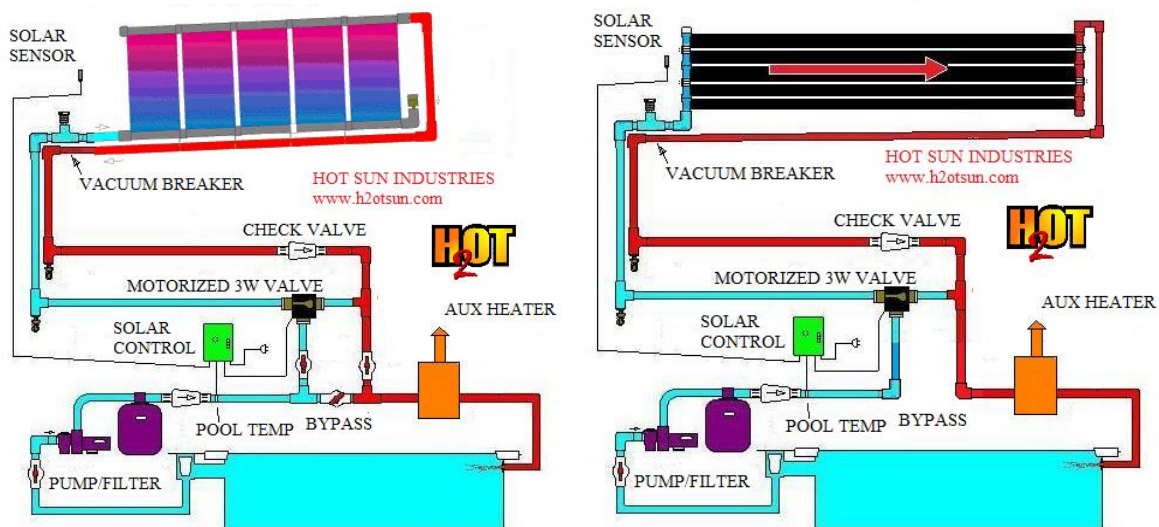
## **2.0 POOL SYSTEM COMPATIBILITY**

Before starting an installation you must check that the pressure where solar ties in (right after the filter usually) is lower than the height of the roof where the solar collector will be located. Beware of infloor

cleaning systems or special cleaning systems that require extra pump speed. Beware of solar collectors located at or below pool level. Beware of pools with older style more restrictive plumbing. If in doubt install a pressure gage at the solar tie in point and compare to roof height. 0.433 psi equals one foot of elevation difference. Make sure you can turn down the variable speed pump's priming speed. The default is full speed which usually will result in too much filtration system pressure. Recognize the possible need to schedule higher speed functions like vacuuming outside the hours of solar operation. The goal is no pressure, no stress BUT we can allow up to 8psi start up pressure and 5 psi normal operating pressure. Contact Hot Sun. There is usually a way but not always. Sometimes a site with adequate sun exposure is not solar compatible.

### 3.0 THE TIE IN:

Our recommended typical solar tie in uses a 3 valve bypass arrangement as shown below left. The reason for this scheme is that it allows anyone to bypass and isolate the solar system from the pool system without having to get into the controls to turn the motorized solar valve. Solar is fully isolated for winter drain down. If the pool is in a non freeze zone and if solar and the pool are not mismatched in size the diagram at the right can suffice. Here all the flow goes to solar so the pump speed must be low enough to not generate excessive collector pressure.



**Fig. 1. General Schematics of Solar Pool Heater Tie-in.**

The diagram above show a typical plumbing scheme. When the roof (solar) sensor gets warmer than the pool temperature sensor (plumbed right after the check valve, CV1) and the pool is colder than the set point you've set on the controller (the maximum pool temperature), the motorized valve will turn and divert flow to the bottom of the bank of solar collectors. The water rises up (or sideways) through the collectors flushing all the air out to the return pipe and back to the pool. When solar turns off after the pool is warm or the solar day is over, the 3 way solar valve turns another 180 degrees so that flow does not go to solar.

The check valve CV1 prevents the water from going backwards through the filter and pump when the pump is turned off. CV2 isolates solar when solar is off. This valve can be omitted if when solar is off the pressure is lower than the roof height such that the vacuum breaker allows some air to enter which breaks the path for reverse flow and loss of heat.

Note the bypass valve in Figure 1. It should always be assumed that we wouldn't be able to send all the flow from the pool pump through all the extra plumbing we add when we install a solar heater. The bypass

controls how much goes to solar when solar is on. It's adjustment is explained below under "Start Up". Controlling solar panel pressure is NOT simply a matter of adjusting the bypass valve. In fact it has little to do with it. Bypassing some flow only eliminates the extra pressure caused by sending too much flow thru solar. Variable speed pumps running slow to minimize filtration cost will have no trouble at all with a 2" plumbed solar heater even if the plumbing run to the solar panels is 100 feet. In cases like this ,instead of the bypass valve the 3w valve can be plumbed directly as shown in the diagram to the right above. Consult Hot Sun.

If the solar heater is to be manually controlled (saving the cost of the automatic controls) the plumbing scheme will usually be identical except that the motorized valve will not be motorized.

Hot Sun systems can be plumbed with 1.5" or 2" pvc pipe. The correct choice depends on the length of plumbing run to the roof and the size of the pool plumbing being tied into and other factors. Consult Hot Sun if in doubt.

## 4.0 CONTROLS

Pool automation systems usually include the brain for solar. In these cases the pool temperature sensor is already in place. All you have to do is plug the actuator (the motor of the motorized valve) into the control panel as well as the wire from the solar sensor and assign the solar valve in the menus. Hot Sun solar sensors are made of a piece of solar panel material to perfectly mimic the temperature the solar panel would be if there was no water flowing through it. Locate the solar sensor in the same sun (shading angle direction) as the solar collector. Note this does not necessarily have to be on the roof next to the solar collector. The wire to the solar sensor can be a direct burial outdoor rated 18 GA wire or it can be inside a conduit. Secure the wire with UV rated black cable ties. Solder and heat shrink the connections. Hot Sun supplies these sensors with any wire length pre-attached.



**Fig. 2. Hot Sun solar sensor. Don't attach to pipe or solar panel.**

Stand alone differential thermostats can be used if the pool automation does not have the solar feature built in. Differential thermostats compare the solar sensor temperature to the pool temperature sensor and the maximum pool temperature setpoint, turning the motorized valve to solar on or off accordingly.

## 5.0 INITIAL SYSTEM START-UP (COMMISSIONING)

**It is very important to check system pressures on a new solar heater.** Start with BV1 fully open. Close the drains, open the 2 isolation valves (BV2 and BV3) fully and turn the 3-way valve to direct flow to the solar panels. Slowly close the bypass valve BV1 until the air flushes out of the solar panels and into the

pool dramatically. The filter pressure will rise as the air flushes through and then settle back to a new lower level. Close BV1 further until you just start to see the pressure gage on the filter start to go up again. We want as much flow as possible without adding extra pressure. You can feel the solar panels when operating in Hot Sun. They should feel pool temp, not hot, and there shouldn't be any hot spots.

If this is the first time the system is started up you should install a pressure gauge on the roof at the level of the solar panels roughly (tee in a pressure gauge on the feed pipe into the solar panels) and check that there isn't any pressure in the solar panels when solar is off (but pump on). An easy way is to use the threaded hole for the vacuum breaker. Then turn solar on and verify the pressure is no more than 5 psi when solar is operating. Do the checks and then replace the vacuum breaker right away. **Do not purposely add pressure.** All you need is less than 1/10 psi to drive more than enough flow through solar. Contact us if there is a pressure situation. Watch the pressure spike as solar turns on and record how much. If it spikes to more than 8 psi it's too much. Contact Hot Sun. **The lower the pressure on the solar panels the better.** Note that if the vacuum breaker is sucking air, you can increase the flow. Close BV1 further but not so far that you add pressure. Make sure the normal operating pressure is less than 5 psi.

You can also control that bypass flow by setting cams on the motorized valve. Some installers prefer this method as it makes the plumbing easier and with variable speed pump running at low speed often we are sending all the flow to solar anyway.

Check vacuum breaker operation. Run solar and then turn the solar valve to solar off. Inspect the fin tubing to make sure it has not collapsed. If the fin tubes collapse every time solar shuts off then over the years it will experience thousands of cycles and eventually fail. If the fin tubes collapse the system needs an additional vacuum break. One will have to be added on the return side. The feed side vacuum breaker can sometimes be moved to the return side to resolve this issue. Then you have to check to make sure the vacuum breaker isn't opening constantly drawing air into the pool. Speed up the flow, use more restrictive return line piping, incorporate some bends in the return piping or add a restricted ball valve to get the vacuum breaker pressure above zero so there isn't a constant stream of air bubbles entering the pool. Vacuum breaker location with respect to return line elevations and plumbing characteristics can be a bit of an art form. Let Hot Sun help. Designing a solar heater to operate "smoothly" means minimal effect on the pool filtration and minimal pressure changes positive or negative as the system operates automatically through time.

Over a design 160 degree temperature swing 20F to 180F manifolds and pvc plumbing will change length by more than 1 inch over 30 feet. Make sure the plumbing can move freely enough to accommodate this kind of movement. Its huge. More than you would assume.

## Commissioning Checklist

**Max start up pressure less than 8 at feed side vacuum breaker location.**

**Normal operating pressure less than 5psi**

**Pump priming solar pressure less than 8 psi**

**Solar off pressure not negative (fin tubes are not collapsed).**

**Horizontal plumbing supported every 36 inches**

**All manifolds secured at ends and every 2 manifolds minimum**

**All piping and manifolds can move 1 inch for every 30 foot plumbing run. Pay attention to corners.**

**Paint all plumbing and pipe connections. UV will go through white PVC and attack glue joints.**

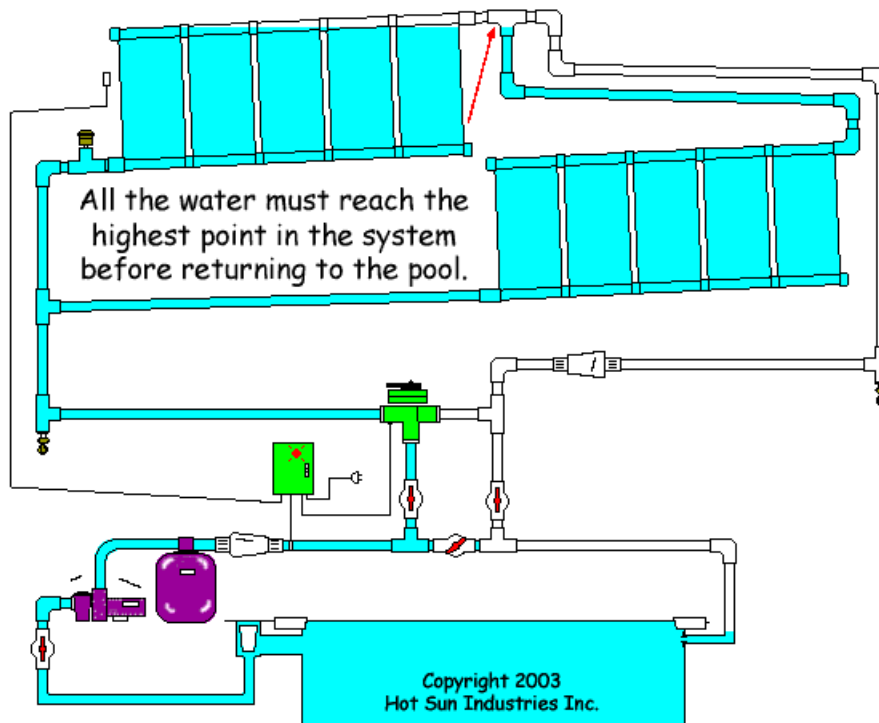
**System and piping can drain by gravity off the roof or manual drains points are located at all low points.**

## 6.0 PLANNING THE JOB

Always plan collector lengths to standard sizes. Custom sizes available by special order. Standard sizes measured outside to outside of manifolds at room temperature are . 29'8", 22' 18", 15' 12", 10', and 8'.

The manifolds are 13" long so allow 13" for each collector section. The high point is where water comes out of the collectors and the low corner is where it goes in. This ensures air can rise up and out of the system naturally avoiding any air pockets trapping flow.

Hot Sun is available for planning consultation.



**Figure 3: Typical Multiple Panel Bank Assembly**

In order to flush all the air out it must be allowed to rise to the highest point in the system as shown in the diagram.

## 7.0 INSTALLATION

For specifics to each roof type see manual addendums.

### 7.1 CONVENTIONAL

Conventional means the flow of water goes up the roof. Water enters at one bottom corner and exits diagonally opposite at the top.

Slope exaggerated

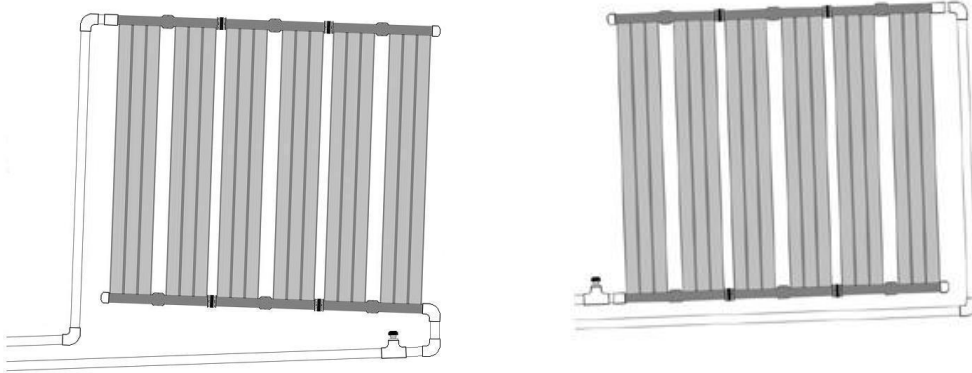


Fig. 2: Sloping panel banks and roof piping

In conventional orientation you have to provide a tilt to the top manifolds so the air doesn't get trapped. A corresponding slope on the bottom manifolds ensures the bottom manifolds drain. Note in the diagrams above, the diagram to the right is preferred so plan your piping to the roof accordingly. The vacuum breaker is teed off the pipe going into the solar collectors. Water feeds the bottom and rises up releasing the air to the return and back to the pool. If the flow is sideways, air is not trapped, and sloping like this is not necessary.

Do not use removable couplings on sch 40 pvc pipe. The pipe will neck down under the heat and stress. Hot Sun supplies adapters.



Adapter



Hot Sun 2" manifolds



Hot Sun manifolds join together several different ways. Our standard 2" MJ coupling joins manifold to manifold. Alternatively, manifolds can be glued together via a piece of 1.5" pvc pipe cut 2" long. You can vary that pipe stub length to work around roof obstructions. This will effectively make it a 1.5" system. If there are two banks, then 1.5" is appropriate. Also, if the pool plumbing is all 1.5" and the run of piping to solar not too long.

We recommend a slope of at least 1 to 120 (1" in 10' or 8mm in 1m) for horizontal manifolds and horizontal plumbing piping and that all piping be painted where exposed to sun. Manifolds and plumbing on flat roof systems do not need to be sloped but means to remove trapped water (for winterizing) must be provided.

## 7.2 PAINTING

Paint the exposed side of the pipe after installation with gloss black paint, not from a spray can. Acrylic paint works best with pvc. Use a brush and small roller. Slide a piece of cardboard between the pipe and the roof as you go. Painting is best done before the piping is attached to the roof but after its plumbed in. Gloss black resists fading better. Black paint allows the piping to collect solar energy. Piping on the side of the house can be painted to match the house. Keep the pipes next to each other for a neat appearance.

## 7.3 COLLECTOR MOUNTINGS

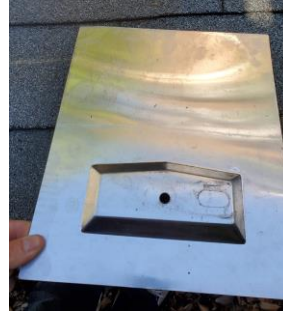
Hot Sun solar panels are secured at the both manifolds, top and bottom, or right and left. Securing both manifold runs satisfies the structural requirement. Additional strapping under the collectors glued or tied to the collectors is intended primarily to keep the fin tubes organized and in position. See drawings for positions.

Refer to manual addendums for each roof mounting type. On flat roofs we employ a ballasted system so there are no roof penetrations. On tile roofs we employ an all adhesive mounting so there are no roof penetrations. On a ground mount we usually build a bed of gravel and install a ballasted flat roof system on that. On a shingle roof we must penetrate the roof because the surface of the shingle has no strength

Our standard tool kit includes vinyl coated stainless steel strapping, strap brackets, strap clamps, plus proper flashed roof brackets all manufactured and supplied by Hot Sun.



**Roof bracket**



**Flashing**



**pvc coated ss strap**

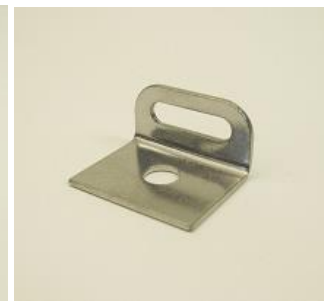
Four #10 stainless steel screws grab the roof sheathing under the shingles. We don't need to hit the rafters. We start with the idea that we want a proper secure flashed roof connection every 6 feet very similar to what we see with a PV system (photovoltaic solar electric). The supplied #10 stainless steel screws can be installed without pilot drilling. Beware ss screws are soft. Its easy to strip the head so use a good bit and be sure to apply accurate force as the screw goes in.



**PL roof and flashing sealant**



**strap clamp**

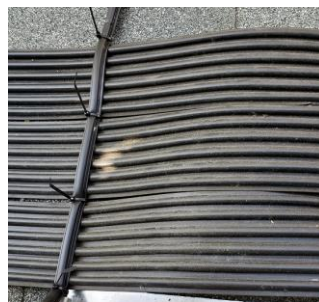


**strap bracket**

Follow the roof mounting methodology outlined in the appropriate manual addendum for the roof type. Consult Hot Sun for variations and other roof types not covered like metal roofing and wood shingles.



**Chain link fence top rail**



**strapping fin tubes**



**PL3x construction mastic**

When using the vinyl (PVC) coated ss strap to strap down the fin tubes we run the strapping under the fin tubes. This is easier than going over because it can be done before the fin tubes are laid out. Glue the fin tubes to the strapping beneath with PL construction adhesive (shown above). Alternatively we use a one tube wide piece of the fin tubing over the top and then sandwich the fin tubes to the strapping every 6 tube wide strip using UV rated black nylon zip ties.

## 8.0 PLUMBING

Glue connections are done using P70 primer and 2711 heavy body PVC cement. Don't use primer on the manifold itself. The manifolds are not PVC. They are a styrene material which reacts more aggressively with the active ingredient in PVC cement and primer, MEK. Fully wet the inside of the fitting and the outside of the pipe using the daubers inside the cans. Check to make sure you don't miss a spot and make sure everything is dry first. Twist  $\frac{1}{4}$  turn as you assemble and wipe off excess. Paint all connections after the glue has dried. UV will go right thru white PVC and attack the glue joints. Take the sharp edge off the end of a cut piece of PVC pipe before gluing. Let the glue dry 24 hrs before sealing the system up. Let it breathe with the drains open and the vacuum breaker removed.



### **Vacuum breaker- mount vertically**

You need to be able to drain water from the piping and header pipes at any low points to prevent damage from freezing (assuming you are in a climate where it does freeze). Slope all the plumbing down to these drains. Mount the unit vertically relative to the center of the earth not the roof surface.

Install the vacuum breaker on the free low corner of the bank of solar panels or preferably on the pipe entering the solar panels. If there is more than one bank of panels the vacuum breaker should be on the bank of panels that is highest on the roof

The vacuum breaker lets air in when the pressure goes below zero to prevent plumbing and solar panels from collapsing. It doesn't vent air or release pressure. The solar system is open to the pool. Air flushes to the pool upon start up. The vacuum breaker also allows air in so water can drain out when solar or the pool pump is off. Without the vacuum breaker the system would go under negative pressure and there would be a risk of collapsed plumbing if temperatures get high enough.

Install 1-1/2" PVC end caps or drain points as needed on the remaining corner(s)

All piping is schedule 40 pvc. Horizontal runs of piping along a wall should be supported every 3' (1m) Underground piping can be buried deep enough that it can stay full of water all winter. Check with a plumber or city hall for the depth required in your area. Alternatively underground piping can be shallow and sloped one way or the other to a drain. A drain pit can be constructed where a large hole is dug (about a

foot deeper than the piping), partially filled with gravel. If you bury the pipe below the frost level you can get away with drains at ground level where the pipes come up. There will be a small column of water that will freeze but it can expand up the pipe.

Remember pvc pipe needs to be able to change length with temperature. A piece of 2" pvc pipe fits over 1.5" perfectly allowing the 1.5" to slide freely while the 2" collar is secured positively. Similarly, 2.5" sch 40 pvc pipe makes a perfect slip collar for 2" pipe.



**Slip collars glued to ballasts (flat roofs)**



**slip collars supporting a plumbing run on a shingle Roof – 2 strap brackets, one screw**

## 9.0 TROUBLESHOOTING and REPAIR

### Air Bubbles:

You should see a big flush of air when the solar heater starts up in the morning. It should stop after a few minutes. If air is entering the pool inlets constantly after the system has started up then the vacuum breaker is probably opening and allowing air to enter. Safely, listen to it. You will hear air entering the vacuum breaker if it is the source of the air. If it isn't, then you have a leak on the pool plumbing before the pump or near the top of the solar panels. Check the pump lid seal. The vacuum breaker is mounted to the bottom header of the bank of solar panels to try and keep some pressure on it so it stays closed. One remedy is to just live with some air bubbles. Another remedy is to increase the pump speed (assuming variable speed). Perhaps the filter just needs to be cleaned or backwashed. That's why the vacuum breaker started sucking air. That's our most common inquiry. You can increase the flow thru the collectors if BV1 isn't closed all the way already. Close it until you see the pressure gage on the filter react. Closing BV1 to send more flow to solar is the same effect as increasing the pump speed. Your pump speed is set for filtering and unless it is set pointlessly too low you shouldn't have to change it to accommodate solar.

### Poor performance:

If you suspect the system is not heating as well as it should be, check the solar panels on a sunny day. When operating (water flowing through them) solar panels will be cool to the touch (pool temperature) across their entire width. Near the bottom of the collector (or feed side) the collector will be close to the swimming pool temperature. Near the top of the collector the temperature will be a little higher (depends on flow rate) but for efficient operation will only be about 5-10 degrees F higher than pool temperature at solar noon. If there is a hot spot, then water is not flowing through this area. Make sure the panels are draining down some when solar shuts down to ensure you aren't losing heat at night.. Without turning the pump off, turn solar off, wait, then on again and make sure you see air bubbles flushing into the pool. This confirms the panels drained down when off. If they don't drain down you could be losing heat if the pump is on at night due to an induced backwards cooling circulation. Install check valve CV2 in Fig 1.

**SERVICE:** You can splice the tubing with ¼" pvc drip irrigation tubing – see repair manual. Beware of polypropylene drip irrigation tubing. Make sure its pvc which is the same as “vinyl”. You can always test it by seeing if it glues to itself with PVC cement or CA adhesive. Gorilla brand superglue- see repair manual (under manuals at [www.h2otsun.com](http://www.h2otsun.com)) is an alternative to buying the CA from Hot Sun . If you have a leak, seal the vacuum breaker location with a plug, run solar, then shut off the pump. Air will be drawn in at the leak location. You can use this method to get 2711 pvc cement to flow into the joint.

Auto Controls: If its not coming on or off automatically the first thing to do is check to make sure the little switch on the actuator is set correctly. It is a 3 position switch. In one position the system operates in reverse so if you change it make sure you remember which position is correct. The middle position prevents the actuator from turning. You can also check the sensors. The two sensors (one on the roof and one in the pool plumbing) are 10,000 ohm thermistors. They measure 10,000 ohms at room temperature. Lower when hotter, higher when colder. If solar isn't coming on when it should, short out the roof sensor at the control panel . If that makes solar turn on then it's a broken wire to the roof sensor or a bad roof sensor. If that doesn't work disconnect the pool temp sensor. If solar comes on (when it should) then it's the pool temp sensor. Parts for these control systems are universal and available worldwide. The motorized valves are pool industry standard parts. Any pool service man has access to all the parts through his local pool equipment distributor.

## **BROKEN MANIFOLDS**

To replace a manifold it is important to understand that the fin tubing can be cut short and stretched. It will become the new length over time. The fin tubes are plastic not rubber. The word plastic means it deforms plastically to become the new size. The new manifold must be glued properly to the fin tubes. Hot Sun can supply the parts needed and instructions.

Addendum manuals covering all the specifics of collector mounting on all the different mounting surfaces are under “ DOCUMENTS AND MANUALS” at [www.h2otsun.com](http://www.h2otsun.com)



Hot Sun Industries Inc  
1440 N Benson Ave. Suite D  
Upland CA 91786  
858-683-0800  
e-mail: [h2otsun@gmail.com](mailto:h2otsun@gmail.com)  
web site: <http://www.h2otsun.com>

## BALLASTED FLAT ROOF MANUAL ADDENDUM 2” MANIFOLDS

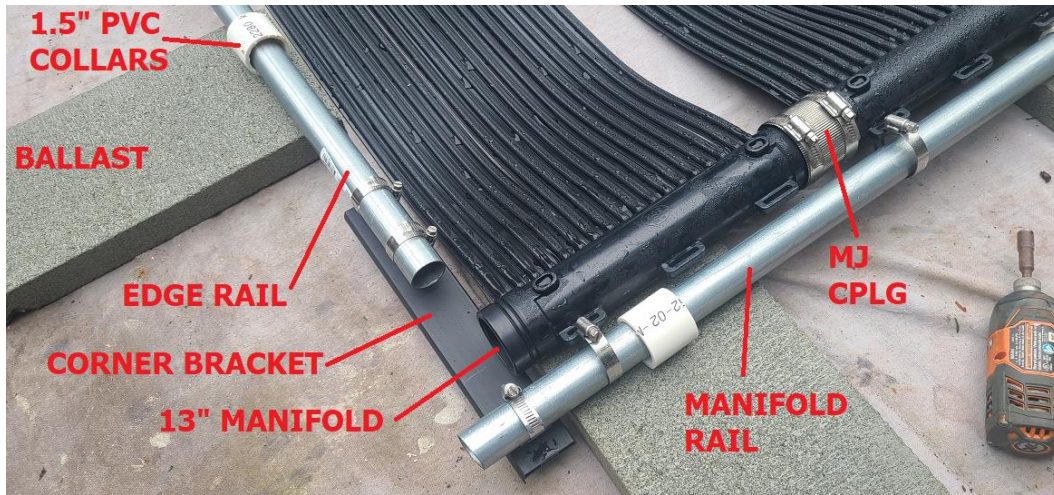
Refer to the General Installation Instructions. This manual addendum only covers specifics to flat roof mounting. Refer to drawing FLAT-1283

Ballasted means weighted. A framework made up of 1-3/8” OD chain link fence top rail is weighed down to the roof with 1.5”x8”x16” patio stones or concrete block caps (ballasts).

**WARNING:** The rails (edge rails, cross rails and manifold rails) can roll if you step on them. The same is true of pvc pipe and even collars. This presents a safety hazard on a roof. Organize things carefully and bring these materials to the roof only as they are installed if possible. PVC cement is toxic. Wear eye protection and don't breathe the fumes.

This design has been field tested extensively but technically it doesn't meet structural wind load requirements so if you are in Florida where there is a hurricane standard or under the scrutiny of a structural engineer you have to glue some of the ballasts to the roof or provide another means such as safety straps to ensure the system stays in place in a major windstorm.





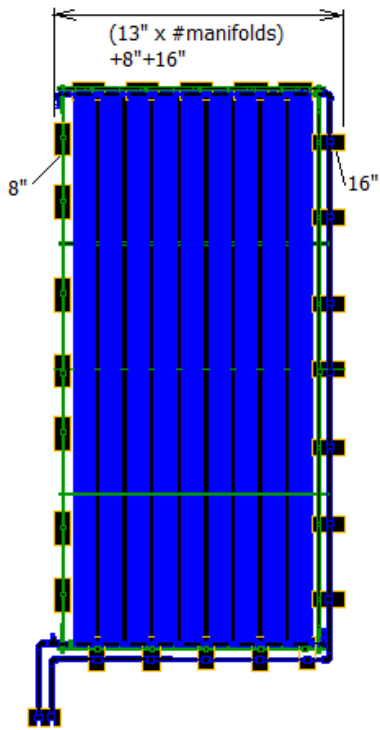
The pvc pipe collars are glued to the ballasts as the last step (PL) but first you must lay out the system so you know where the plumbing will run because on some sides the ballasts will be oriented perpendicular to the rail as in the diagram above. This way plumbing can be supported by the same ballasts. To save space orient the ballasts parallel to the rails if no plumbing supports are needed.

## LAYOUT:

Our fin tubing is made in 88' rolls. This means that in order to minimize waste we want fin tube lengths to be factors of 88'. Try to lay out the system such that the lengths are approximately 12', 15', 18', 22', 29', 44' or 88'. We normally try to sell these systems prefabricated (fin tubes cut to length and glued to manifolds) to these standard lengths. For cutting and gluing on site to fit the space, refer to the General Instructions and videos.

Each manifold occupies 13" exactly when coupled together with Hot Sun MJ couplings.

It is important to look at the elevations of the roof. Flat roofs will have some slope and near the edges of the roof slopes may change to direct water. The water should exit banks of solar collectors at high points in the roof. In other words the highest corner of a bank of solar collectors is the return. Flow through the fin tubes can go across the slope of the roof or up the slope of the roof.



Note ballast orientation to support plumbing

Apply zinc paint on cut/filed ends of rails

In the above simple example of a single bank of Hot Sun collectors water leaves the system at the highest point, the top right. Note the orientation of the ballasts to accommodate the piping. Water always goes in diagonally opposite where it comes out. Contact Hot Sun for help laying out a multi bank plumbing scheme. In multiple bank scenarios as in sloped roof plumbing all the water has to reach the common high point before exiting. Water from the high points of individual collector banks must flow uphill to the common high point. Roughly lay out all the ballasts to accommodate collectors and plumbing. Its important the ballasts are 1.5" tall because this will orient the cross bars to be above the fin tubes precisely. If the roof surface is sensitive glue or place 7.5" long pieces of fin tubing under the ballasts.

## ASSEMBLE THE COLLECTOR BANKS

Refer to the drawings FLAT-1283 for the recommended ballast, cross bar and strap locations. The primary purpose of the cross bars are to hold the system down in wind. The purpose of the straps underneath the fin tubes is to keep the fin tubes arranged uniformly.



Cross rail over fin tubes last



Strap under fin tubes first

The Hot Sun PVC coated ss strap (strap) goes down first (under the collectors) at the right locations (refer to drawing). The straps will be wrapped around the ballasts and tied off to the edge rail with strap clamps. All the gluing with PL adhesive happens once the system is complete. It can take a few days to set up fully.

Note cross rails are located within 6 feet of the manifold assemblies and 10' max from other cross rails.



With ballasts and straps located and positioned, lay out the Hot Sun solar panels and couple together with Hot Sun MJ couplings. Torque the MJ coupling's two gear clamps alternatively to 30 inch pounds. The screws of the MJ couplings must be on top the coupling so they don't interfere. Note, instead of removable MJ couplings, you can glue 1.5" pvc pipe inside the Hot Sun manifold to space around obstructions and to add caps or drain points to the ends of manifold runs. Heavy body grey pvc cement is recommended. Do not use primer on pvc connections to the manifold. The manifold is not pvc.

Next position the cross rails and install the edge rails and manifold rails starting with one corner. Corners joining manifold rails to edge rails are done using Hot Sun corner brackets and 3) #20 gear clamps.



Edge rails and manifold rails sit on the ballasts via short pieces of 1.5" pvc pipe (collars). These will be glued to the ballasts in the last step using PL. The purpose is to create a solid but slightly flexible connection to the ballasts that allows for the system to be taken apart and also to elevate the rails to the correct position. Secure the manifolds to the manifold rails using loose #20 gear clamps around the manifold rails and through one of the 3 tabbed slots molded into the manifolds. Very loose so that the manifolds can expand and contract without interfering with the collars. Think about expansion and contraction with temperature change of the plastics. The plumbing piping and the manifolds will expand and contract in proportion to their length. PVC pipe will expand and contract a full inch over a 30' length over the temperature range we expect. The flexible fin tubes do not expand and contract because they are flexible. They just flex.

Cross rails can now be secured to edge rails to complete the frame. Cross rails can extend past the edge rails to provide additional support for piping so plan the plumbing carefully first.

## PLUMBING

Drain points are installed at the two free corners. These are glued using 2711 heavy body grey pvc cement via 1.5" slip x 1/2" fip bushings, a 1.5" elbow, and a 2" long stub of 1.5" pvc pipe. Tilt the elbow down so the drains exhausts more of the water left in the manifolds over winter. Note that when gluing into the manifold we do not want to use primer. The manifold material reacts more aggressively with pvc cement than pvc so the primer can damage the manifold if it puddles. You can use primer and pvc cement on all pvc to pvc connections of course. Think again about the movement of long lengths of pvc pipe. On 2" pipe use slip collars made of 2.5" pvc pipe. On 1.5" pipe the slip collars are 2". Don't glue the collars to the ballasts (last step) that are near the corners. This allows the piping to expand and contract. Note the piping connection to the cross bar shown below can allow for this movement. Plumbing must be supported at most every 3 feet to prevent the piping from sagging when the system gets hot.



Tight gear clamps allowing PVC pipe to shift.

The vacuum breaker tees off the pipe entering the system, the feed. It must be positioned vertically as gravity plays a role in its operation. Note that if the feed point on a bank of collectors is lower in elevation then the far end doesn't have to be drained. It's a good spot to elbow up to a vacuum breaker.

If you want to maintain 2" flow capacity, the connections to the feed and return pipe can be done with Hot Sun adapters or with glued on 2" pvc 90 degree elbows. These 2" elbows must first be drilled and cut to create relief for the nipples.



Elbow with relief



Hot Sun cpvc adapter

You can not use a removable coupling (the 2" MJ coupling) directly on pvc because the pvc will neck down under the stress of the gear clamp when things heat up. The system will get very hot stagnating in hot summer sun with the pool up to temperature.

The solar sensor should see the same average sun as the collector array. A good location is glued right onto one of the ballasts. Do not mount the sensor to a pipe or to the solar panels as we want it to mimic the temperature the solar panels would be at when no water is flowing through them.



The sensor wire should be outdoor rated. Hot Sun sells it by the foot and soldered to the roof sensor. Alternatively you can use conduit. The wire gauge size should be less than 22GA (larger is smaller in wire gauge). We use 2 wire 18GA stranded and shielded outdoor rated wire. Tie wire off to the piping using black nylon 10 ties.

Once the system is fully plumbed and wired paint all the white pvc piping black using flat or gloss black paint out of a can. Acrylic paint is best for PVC but a good rust paint also works well. Paint from spray bombs fades off over time. Use a small roller brush to get under the piping. Nothing is glued to the ballasts yet so it's easy to lift and move piping as you paint. The paint dries quickly.

Next run the system and check for leaks assuming all the plumbing to the pump house is also complete. Refer to the general instructions for wiring and plumbing at the tie in and start up.

Finally glue all the slip collars to the ballasts using Loctite PL Premium 3x construction adhesive. In Canada its Lepages premium 3x (shown above). Rotate the slip collars a little as you apply the mastic to get better contact underneath. Remember not to glue slip collars on pipes at corners where expansion and contraction of piping must be allowed for. Glue down the slip collars, the roof sensor, and glue the fin tubes to the straps beneath them. A little dab of PL between each 4" wide fin tube and the strap below is quick and easy and secure and if you ever had to remove the system you can just cut the strap between the one foot wide sections. Its messy. Carry a rag, wear gloves. It won't come off your clothes. It is better to use the smaller caulking tube size rather than the large tubes due to the fact once you start oozing it out it keeps coming. Have a rag handy. Buy the PL at most hardware stores. It is the most common and popular construction mastic.

Once the system is complete you can check that you plumbed correctly by feeling the collectors on a sunny day with water flowing through them. If you feel hot collector surfaces these are areas that aren't getting flow. If you can detect a difference in the outlet temperatures (the collector surface temperature near the return end) then flow needs to be increased to the warm section. First make sure air can rise up out of the system by checking that pipe does not slope down where air must be released up. If one bank is significantly larger than another you may find it gets less flow. You can add a ball valve before the smaller bank and adjust it to force more flow to the larger bank.



**Hot Sun Industries Inc**  
 1440 N Benson Ave. Suite D  
 Upland CA 91786  
 858-683-0800  
 e-mail: [h2otsun@gmail.com](mailto:h2otsun@gmail.com)  
 web site: <http://www.h2otsun.com>

## BALLASTED STAGGERED FLAT ROOF MANUAL ADDENDUM

Refer to the General Installation Instructions. This manual addendum only covers specifics to flat roof mounting. Refer to drawing FLAT-1000

Ballasted means weighted. In this design concrete is used as ballast. A framework made up of 1-3/8" OD chain link fence top rail and P4100 slotted shallow Unistrut is weighed down to the roof with 1.5"x8"x16" patio stones or concrete block caps. Don't use full height Unistrut. Use the smaller profiled shallow version. This design has been field tested extensively but technically it doesn't meet structural wind load requirements so if you are in Florida where there is a hurricane standard or under the scrutiny of a structural engineer you have to glue some of the ballasts to the roof.

### LAYOUT:

First plan the layout remembering the fin tube rolls are 88 feet long. Make a roof plan based on 1/2, 1/3, 1/4 lengths etc., in other words 88 foot, 44 foot 29 foot and 22 foot lengths and shorter. It is important to look at the elevations of the roof. Flat roofs will have some slope and near the edges of the roof slopes may change to direct water. The water should exit banks of solar collectors at high points in the roof. Flow through the fin tubes can go across the slope of the roof or up the slope of the roof. Plan the piping because you need to leave room for it and you will orient side ballasts to accommodate framework and plumbing.



Fin tubes are flexible so they can be arranged to avoid roof obstructions and you can even curve the system to fit unusually shaped roofs.

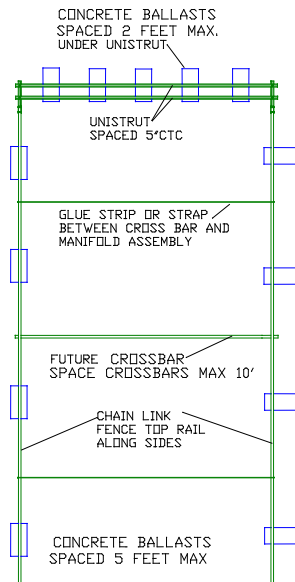
Flat roof systems are almost always done with staggered manifolds so that we eliminate the spaces between adjacent sections. Each manifold corresponds to 3 fin tube strips that occupy 11.25" each. Ten fin tube sections (30- 6 tube wide strips) will need 112.5" between ballasts.



First lay out the ballast blocks. Its important they are 1.5" tall because this will orient the cross bars to be above the fin tubes precisely. If the roof surface is sensitive glue 7.5" long pieces of fin tubing under the ballasts as shown. Use Loctite Premium 3x PL (PL). Alternatively these pads can be placed under as the last step and because the ballasts never move they don't need to be glued.

Space your ballasts along the edges of the future fin tubes as a guideline.

Before laying out the fin tubes figure out where the glue strips or cross straps are going because they go down first. The system is built based on grids of 10 manifolds by ten feet so if the fin tubes are 29 feet long there will be 2 cross bars over the fin tubes spaced 10' from each manifold location. In between those and the manifolds and each other are the glue strips or straps. Once the fin tubes are cut to rough lengths wasting as little material as possible assemble the manifolds at one end.



Glue strips are made of 2 tube wide Powerstrip fin tubing.

For a more wind resistant design or to make the system easier to roll up for roof resurfacing use vinyl coated ss strap instead of glue strip. Secure it to the edge bars using strap clamps (later). Once the fin tubes are over top the vinyl coated ss strap, lay a one tube wide piece of fin tube material over that and sandwich the fin tube strips in between with UV rated black nylon ties. Do this after you have assembled all the manifolds because adjustments can be made if necessary. Trim the tag ends with wire snips.



The manifolds all face the same direction. Between each manifold is a pvc coupling and a piece of 1.5" pvc pipe approximately 10-5/8" long and slip collar. Chamfer the ends of the pipe before gluing so the glue doesn't "squeegee" off. Use P70 primer and heavy body grey PVC cement on all glued connections except to the actual manifolds where we skip the primer (the manifolds react more aggressively with the PVC cements). Glue the fin tubes onto the manifolds (CA) before gluing the manifold assembly together. Rotate the headers so the fin tube does not abrade on the concrete blocks. When gluing be aware of the alignment of all the nipples of all the headers as you work.

Number 44 - 316 SS hose clamps go over the slip collars (short pieces of 2" pipe) and around the unistrut as the last step. Don't forget to slip the slip collars over the intermediary pipes before gluing them to couplings and manifolds. Make sure the assemblies slide within the slip collars. Do not overtighten the hose clamps.





The Unistrut lengths are separated by a distance of 5" center to center or to match the spacing created by the tee and elbow at the corner where water enters or exits. If plumbing is 2" use a 2" tee, bushing and a 1.5" elbow.



Clamp the edge bar (chain link fence top rail) to the 12" Unistrut using a #32 all 316 SS hose clamp. Two are shown in the photos above but only one is necessary.

At the edge bar locations (somewhat central on the ballasts) create the corner of the framework using a 12" piece of Unistrut. Bolt it to the long unistruts to fix their position using two electroplated 3/8" bolts, washers and Unistrut nuts (without springs) as shown. This creates a space for plumbing to extend out from the manifolds.



As you glue the manifolds to the 9-5/8" long intermediary pipes and couplings you may have to adjust the lengths of these intermediary pipes as necessary to line fin tubes up with each other.

Before working on the other end of the fin tubes where you will create another manifold assembly straighten out all the fin tubes. Pay attention to the look of the fin tubes as the outer row goes over the inner row of manifolds. When you glue the tee and elbow on the feed or exit end remember that this will fix the rotation of the manifold assembly.



Use a chalk line and/ or the 2 lengths of Unistrut to mark the cuts on the fin tubes 5" apart. Cut the longer fin tubes first and attach those manifolds first. Then fold these out of the way before cutting the shorter fin tubes and attaching those manifolds. This way you can't make a mistake and cut a long fin tube short or glue a header to the wrong fin tube.



The edge framework can be clamped to the concrete pads with pipe/conduit via a sleeve of 1.5" pipe. The two hole pipe clamp and pipe sleeve can simply be glued to the concrete pad using Loctite PL Premium 3x construction mastic as the last step. This loose sleeve connection provides some flexibility in positioning relative to the uneven roof surface. These chain link fence top rails can also be bent to follow the roof shape.

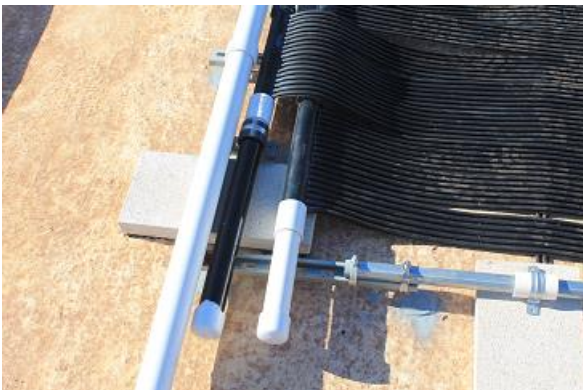
The above general assembly should occur every 10 Powerstrip manifolds or so. In other words one bank can be 10 or 12 manifolds wide but if you did a bank of 20 manifolds you would add another edge assembly down the middle or create two separately plumbed banks. You have to be aware of that when plumbing the manifolds because the intermediary pipes will be longer.



Cross members should be spaced about 10 feet starting from the manifold assemblies. One inch rigid conduit 2 hole or 1 hole pipe clamps with #20 all SS hose clamps can lock the cross members in place. The cross bars sit exactly on top the fin tubing and serve to hold the solar collector down just like a big strap right across it but stiffer.

The ends of the glue strips go can under extra concrete ballasts and then tie off to the framework. Once the job is complete arrange all the fin tubing so it is straight and evenly spaced and then glue the glue strip to the underside of the Powerstrips using PL.

Using PL glue to the ballasts to the Unistrut with construction mastic as the last step. Glue the ballasts to the edge rails with PL via the 1.5" pipe collar and 1.5" 2 hole pipe clamp. Notice that we specified a ballast between each cross bar and glue strip or strap. If you add a ballast at each strap/glue strip location the glue strip or strap can go under the ballast which will mean the fin tubes aren't elevated at the edges. You may want to elevate the fin tubes as much as possible to improve cooling of the building underneath. You may want everything laying flat for better esthetics.



The plumbing to and from solar can be done with 2" pvc pipe or 1.5" depending on the flow capacity required. On flat roofs we still have to think about air getting trapped at high points. You want to return water (water leaves solar) at the highest corner so air will release naturally to that point. A 2" tee, 2 bushings and an 1.5" elbow are used at the in and out corners. At the other 2 corners of the bank do not tee or double elbow the headers together. Instead use two drains at each corner. It's a good idea to create the ability to get water out at these 2 free corners. Since its elevated why not use 1.5" 45's , bushings and hose bibs

or 1/2" threaded plugs? Every situation is different. One reason we elevate the header assembly is so the drains can be angled down to fully empty the header assembly.

If the plumbing is 2", then short 2.5" pvc pipes can be used as collars to allow movement with temperature.

Plumbing can share the ballasts or you can add another short piece of Unistrut to the two under the manifolds and use that to support plumbing running parallel to the manifold assemblies. Hose clamp the slip collar to the Unistrut through the slots. Note the Unistrut should be open side down. Whenever you cut Unistrut you need to file the ends and paint with zinc paint



Its important to paint all PVC pipe and fittings with a brush and small roller not with spray paint. Acrylic paint is best for PVC but we have had good success with regular rust paint from a can (not spray paint). Oil base paint is not necessary. Use latex for easy clean up. The purpose of the paint is to protect the PVC glue joints from UV. Interestingly UV penetrates white PVC pipe and attacks the glue joints over a fairly short time frame. Let the pvc cement dry before painting and before sealing it up and running water through it.



Distributed and serviced in the USA by  
Hot Sun Industries Inc  
1440 N Benson Ave Ste D,  
Upland CA 91786  
858-683 0800  
e-mail: [h2otsun.com@gmail.com](mailto:h2otsun.com@gmail.com)  
web site: <http://www.h2otsun.com>

## SHINGLE ROOF MANUAL ADDENDUM – CONVENTIONAL ORIENTATION

Usually flow is up the roof when the roof is pitched. Manifolds are across the bottom and top. We call this conventional orientation as opposed to sideways where we run fin tubes horizontally.



**WARNING:** The rails that go top and bottom can roll if you step on them. The same is true of pvc pipe and even collars. This presents a safety hazard on a roof. Organize things carefully and bring these materials to the roof only as they are installed if possible. PVC cement is toxic. Wear eye protection and don't breathe the fumes.

Conventional means the flow of water goes up the roof. Water enters at one bottom corner and exits diagonally opposite at the top.

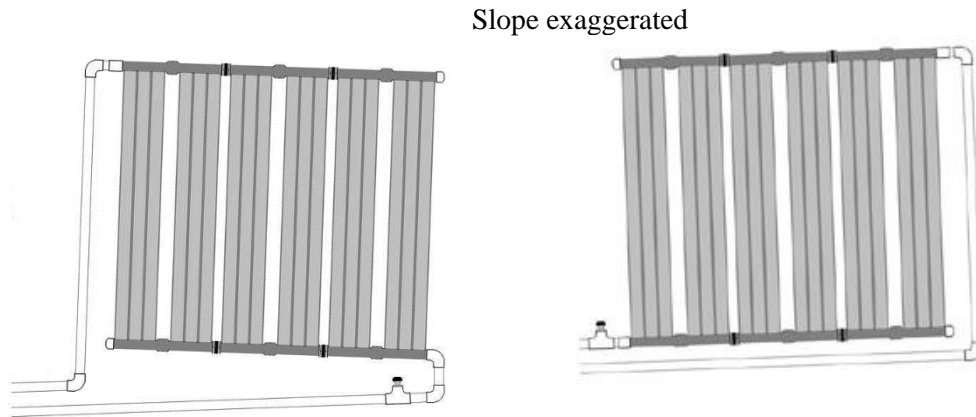


Fig. 2: Sloping panel banks and roof piping

In conventional orientation you have to provide a tilt to the top manifolds so the air doesn't get trapped. A corresponding slope on the bottom manifolds ensures the bottom manifolds drain. Note in the diagrams above, the diagram to the right is preferred so plan your piping to the roof accordingly. The vacuum breaker is teed off the pipe going into the solar collectors. Water feeds the bottom and rises up releasing the air to the return and back to the pool. If the flow is sideways, air is not trapped, and sloping like this is not necessary.

## LAY OUT THE SYSTEM

The manifolds occupy 13" each. Leave at least one foot to the roof edge. This is because wind effects are strongest near the roof edge. Also esthetically you want to center the array of solar collectors on the roof space. Install the first roof bracket approximately 2 feet in from the roof edge. This roof bracket will normally be as high on the roof as possible without interfering with the ridge cap. Install the first mounting block at the side of the roof where the plumbing enters the roof space. Locate it low on the shingle so that you can create a sloped support bar angling up on one course of shingles (so you don't have to overlap the bottom of a shingle).



Position first roof mounting block low on the shingle. Before screwing it in make sure the flashing goes in.



A scraper can be used to break the seal between shingles so the flashing can slide in.



If the flashing doesn't go in far enough due to a nail just cut it shorter with tin snips



Apply roof sealant, black silicone or polyurethane roof sealant, to the underside of the block, then flip it over into position and screw into the roof using the supplied 2" long csk head #10 ss screws. Be careful not to strip the head of the screw. Stainless steel screws are soft and can easily strip. Make sure your bit is in good shape and apply straight firm pressure with your impact driver seating the 4 screws evenly.



Install the strap bracket, ss washer, 1/4" ss nut and a #20 all ss gear clamp and tighten (the nut).

You have just installed the absolute best flashed and sealed roof connection for a solar pool heater. The bracket does not have to hit a rafter under the sheathing. The 4 screws grab the sheathing securely.



Next run a chalk line from the first roof bracket across the roof planning to use up the width of a shingle to create the slope we want. Any slope at all will do. In fact what is important is that air can rise up out of the system naturally. We don't want to trap that air so as long as the slope is at least zero we're alright. Sloping up left to right means the right side is where water will exit the system. You can reverse all this of course if you want the high point to be on the left instead. Generally what we want to do is make the low corner of the bank of collectors closest to the place where the piping comes onto the roof. This is because the return pipe is going to run down the right side (in this example) of the collector bank and parallel to and below the bottom manifolds. It's a cleaner look and easier to hang that return pipe from the bottom manifold rail. Hence the rule of thumb is that everything slopes up and away from where the piping enters the roof area. Note, this determines which pipe is which on the plumbing run from the pump/filter.



Install the second roof bracket approximately 6 feet from the first one. Assemble the flashing and clamp the chain link fence top rail (available at hardware stores (not included with Hot Sun kits)). The #20 gear clamps that secure the top rail should allow the top rail to expand and contract so

make the first one tight and the others slightly loose. Metal doesn't move nearly as much as plastic with temperature but over a long length the movement could stress the roof connection.



Next we roll the collector down the roof carefully. Don't let it get away on you otherwise you may have to solve a rubik's cube to untangle the 3 strips from each other. Use two loose #20 gear clamps to secure the top manifold to the cross bar. Make sure the connection of the top rail to the roof bracket does not interfere with the free movement side to side of the manifold. Straighten and make sure the collector is evenly spaced from the edge of the roof assuming the edge of the roof is orthogonal. The #20 gear clamps that secure the manifolds to the rails must be very loose leaving a gap between the manifold and the rail to allow relief so the manifolds can expand and contract freely.

Now that once we have one collector in position we can locate the lower top rail. We call the bar a top rail. This is short for chain link fence top rail. Note the collector can and should stretch into its final position.



Note that on this roof connection below the collector you want the strap bracket positioned up the roof opposite of the way you did the top connection. You are pulling the collector down the roof. This connection secures the bottom manifolds securely. This provides 100% of the structural requirement to keep the system on the roof.

Note that other collector types can not be installed this way because they are made of a rigid polypropylene or a flexible synthetic rubber. These materials will pull too hard when they contract as temperature drops. Only the Hot Sun system can be secured positively top and bottom ensuring wind can not lift a bottom corner and create a chain reaction ending with your collectors in your neighbor's yard. Position that roof mount so that you have to stretch the collector about an inch to clamp onto the chain link fence top rail. Remember to slope the chain link fence top rail to match the upper one.



Before installing the second collector, run a strap or straps across the roof. At Hot Sun we use a pvc coated stainless steel strap (we supply). Install this strap under the collectors (install it before the solar panels). Its primary function is to keep the collector strips arranged so they doesn't flip around on the roof and need to be straightened after a wind storm. It's much easier to install straps before collectors are installed. The collectors will be glued (PL premium 3x) to the strap as the last step once everything is perfectly positioned. The strap should be no more than 6 feet from the manifolds top or bottom and spacing between straps should also not exceed 6 feet. If the location is extremely wind exposed a spacing of 4 feet can be chosen. In this example case the collector is 12 feet long so we install one strap half way between upper and lower top rails.



First make a flashing using a 6" wide roll of aluminum roof flashing available at hardware stores. Cut rectangles about 3" x 6" and nip the sharp corners off. Break the seal between shingles as before and slide the flashing up between shingles at the location you want. Apply some sealant (black silicone or pl roof and flashing sealant- NOT the PL mastic used for gluing strap to fin tubes) under the flashing and screw the strap bracket through the flashing into the roof. This roof connection is sealed well because metal to metal is sealed with sealant easily and the flashing keeps water off the actual roof penetration. There is very little stress on this roof connection because it does not take any weight.



Position additional roof connections so that they line up between the collectors every 6 feet or so. Each collector occupies 13" so 6 collectors is 6'6". Install the end roof connections first, install the strap tight, then mark the position of the middle strap brackets with a pencil. Its not critical the strap brackets line up with the space between collectors but why not? Don't try to fish the strap through mounted strap brackets. Instead slide the middle strap brackets along the tight strap, rotate them so the screw can go in, then rotate the strap brackets perpendicular to the strap using a pliar or hammer claw. Note the strap can be perfectly horizontal. It doesn't need to be angled like the top and bottom rails.

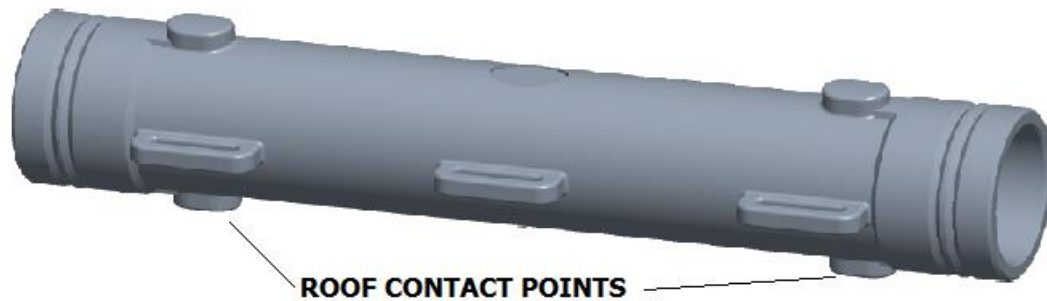


Roll the second collector down the roof carefully and assemble the removable 2" MJ couplings to join the manifolds. This is a standard mechanical joint coupling used in the plumbing trade available at hardware stores. Tighten the gear clamps alternately to a final torque of 30 inch lbs (hand tight with a 5/16" nut driver). Keep the shield positioned as you tighten and keep the gear clamp nut on top so it doesn't interfere.

Stretch the solar panels and clamp loosely to the bottom rail so everything can expand and contract freely side to side. One #20 gear clamp per collector, two on the first one and the last one in a bank. Do the plumbing before gluing the fin tubes to the underlying strap(s) with PL premium 3x construction mastic.

The manifolds will expand and contract side to side as temperature changes. To protect the shingles from this you can install flashing material under the manifolds at the contact points or slide 6" long spacers (Hot Sun supplied) under the manifolds between the manifold's contact points.





## PLUMBING:

Note the inside of the manifold ends are standard 1.5" pvc sockets. If the system is plumbed in 1.5" the manifolds can be joined together with 2" long stubs of 1.5" pvc. To remove a manifold simply cut between manifolds through the stub and rejoin the new manifold with removable 2" MJ couplings. The roof contact points maintain the position off the roof so everything is still inline. Use heavy body grey pvc cement and don't use primer on the manifold connections. The only reason we don't specify other cements is we haven't tested thousands of them over 20 years. Usually on 1.5" plumbed systems we will choose to use removable 2" MJ couplings between collectors but corner connections to feed and return pipes are simply glued in with 1.5" pipe.

The vacuum breaker doesn't have to go on the feed pipe entering the collectors. It can go onto the opposite end of the lower manifolds with an 1.5" elbow glued vertically even on a 2" plumbed system.



Rule of thumb for vb placement is at the same elevation as the lower manifolds. If there are two banks, locate at the elevation of the bottom manifold of the upper (higher) bank.

Its not a bad thing to restrict flow into the system a little. This is because in high flow conditions the restriction is before the collector bank reducing collector pressure. High pressure stresses the solar panels so we are always looking for low pressure in the actual collectors. So even if the

entire system is plumbed in 2" pvc its often OK to restrict the flow at the inlet where water enters (bottom low corner of collector bank). When gluing into the manifold use heavy body grey PVC cement (2711) and don't use primer. This is because the manifolds are not PVC. They are ASA which reacts more aggressively with MEK, the active ingredient in pvc cements and primers. Use primer before cementing all pvc to pvc connections.

To maintain maximum flow capability on 2" systems there are some options.



Don't use the MJ coupling directly on pvc pipe. Hot Sun supplies a CPVC adapter.

The upper corner above the inlet (the low upper corner) is capped so use a stub of 1.5" pvc and an 1.5" cap. Easy.

The piping connections in and out of the collector bank can be done with a glued on 2" elbow or coupling. The outside of the manifold is the same size as 2" pvc pipe but the nipples get in the way of slipping the fitting all the way on. Just drill a 1/2" hole in the elbow to create a relief where the elbow would otherwise interfere with the fin tubes. Then cut away the excess pvc with a hacksaw.



Alternatively cut the fitting down by 1/2" to avoid interference with the first flow core.

Return piping running parallel to the bottom manifolds can be hung from the rail every 3 feet using a piece of pvc coated ss strap and a strap clamp as shown below.

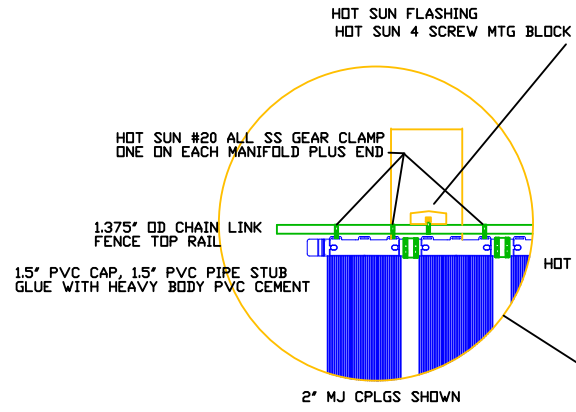


Finally once the system is plumbed in straighten all the fin tubes, get them exactly where you want. Then simply apply a dab of PL to every fin tube strip tacking it onto the pvc coated ss strap underneath.

Don't forget to paint all white plumbing so UV doesn't attack the glue joints. UV goes right through white PVC pipe. Use a 6" roller and gloss black or flat black paint from a can. A 1" brush gets into the tight spots. Spray paint is faster but it'll fade over time.

Hot Sun spacers can be used under piping near elbows to elevate the elbows off the roof so they don't damage the shingles as the piping moves with temperature.

See Hot Sun installation manual for other details.



HOT SUN STRAP BRACKET  
HOT SUN #20 ALL SS GEAR CLAMP  
1.375" OD CHAIN LINK  
FENCE TOP RAIL

HOT SUN 4 SCREW MTG BLOCK

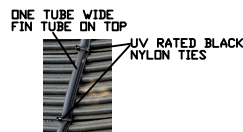


HOT SUN FLASHING



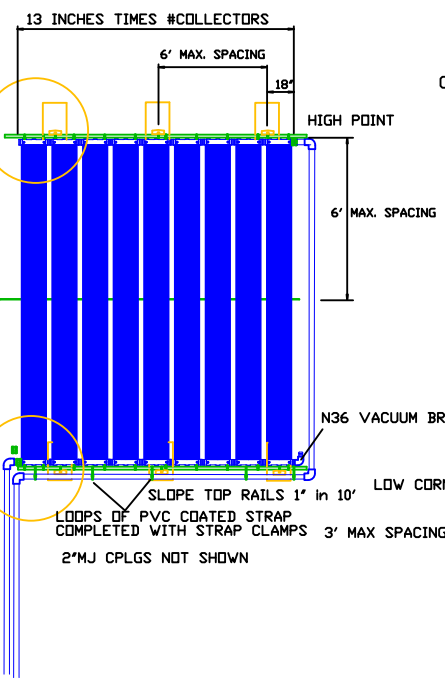
HOT SUN STRAP BRACKET  
HOT SUN #20 ALL SS GEAR CLAMP

SLOPE TOP RAILS 1' in 10'



ONE TUBE WIDE  
FIN TUBE ON TOP  
UV RATED BLACK  
NYLON TIES

OPTIONALLY GLUE FIN TUBE  
STRIPS TO PVC COATED SS  
STRAP BENEATH WITH PL 3x  
PREMIUM CONSTRUCTION ADHESIVE



1.375"OD GALVANIZED  
CHAIN LINK FENCE TOP RAIL

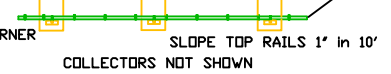


HOT SUN STRAP BRACKET  
3"x6" AL ROOF FLASHING



HOT SUN PVC COATED 304SS STRAP

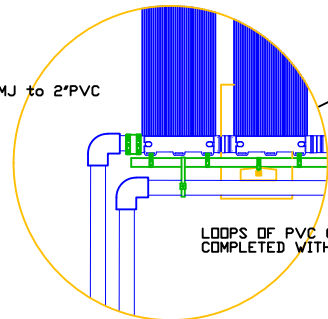
1.375"OD GALVANIZED  
CHAIN LINK FENCE TOP RAIL



STRAP CLAMP  
SECURES END

SEE MANUAL ADDENDUM  
SHINGLE ROOF CONVENTIONAL

ADAPTER 2" MJ to 2" PVC



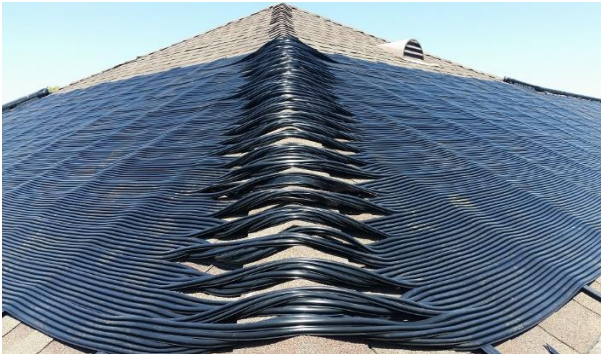
HOT SUN INDUSTRIES INC. 1440 N Benson Ave Ste D Upland CA 91786 858 683 0800 www.h2otsun.com		HOT SUN SOLAR CONVENTIONAL ORIENTATION FLOW UP THE ROOF	
ECH/SC	NO. DESSIN / DWG NO.	GR/SIZE	
DATE	Nov 20, 2023	SHINGLE-1283	
PAR/BY	KEN WRIGHT		
VER/CHK			



Distributed and serviced in the USA by  
Hot Sun Industries Inc  
1440 N Benson Ave Ste D,  
Upland CA 91786  
858-683 0800  
e-mail: [h2otsun.com@gmail.com](mailto:h2otsun.com@gmail.com)  
web site: <http://www.h2otsun.com>

## SHINGLE ROOF MANUAL ADDENDUM – SIDEWAYS

Running the fin tubes horizontally so the flow is left to right or right to left allows the system to be fitted to the roof. Manifolds at the left or right can be angled to match the roof space and fin tubes can bend around inside and outside corners.



### STEP 1) PLAN THE LAYOUT

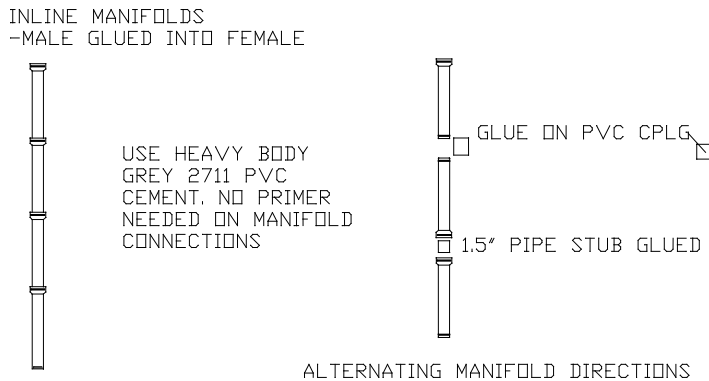
Remember that the fin tubes are 88 feet long so plan the job so your average lengths are 88, 44,29,22,18 feet etc so you don't waste too much material.

**STEP 2) INSTALL UNISTRUT AT ONE END**

The design idea this system is based on is that we want discrete proper flashed roof connections. Hot Sun roof brackets and roof flashings can take either two or one length of Unistrut. The manifolds are attached to these Unistrut so that they are supported and can freely move with temperature.

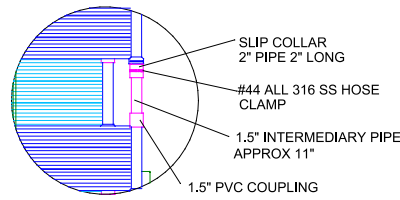


P4100 shallow slotted Unistrut is bolted to the flashed roof brackets. The roof brackets are located, then screwed into the roof with 4) #10 csk head ss screws each. These roof penetrations are sealed with a roof and flashing sealant. The flashing slides between shingles to flash over this roof bracket. You will have to break the seal between the shingles so you can slide the flashing between. This is done with a sharp thin piece of metal forced up between the shingles. Seal the hole in the flashing where the stud comes through as well.

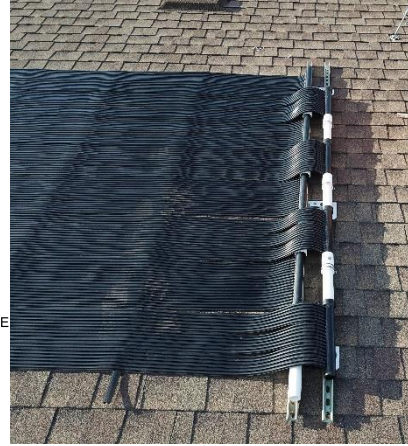


Usually sideways installations like these involve less than 12 manifolds in a row. We want to make best use of available roof space yet we still want to leave a little space between fin tubes to relieve air pressure and to allow the roof to breathe.

Because of these 2 factors we often glue the manifolds inline meaning the male end is glued into the female end and so on. Inline manifolds use up 12.5" each so 9 will fit on a single ten foot length of Unistrut. A ten foot length of Unistrut should be secured to the roof via flashed roof brackets at 3 places, one in the middle and the other two approximately one foot from the ends. If for example the Unistrut is 12 feet long you should use 2 pieces 6 feet long and 2 roof brackets per piece for a total of 4 roof connections. Unistruts can be joined together with Unistrut joiners which are just flat bars with 4 holes using 4 nut/bolts and 8 washers. Run a chalk line and screw the roof brackets into the roof and flash them. Bolt the Unistrut in place.



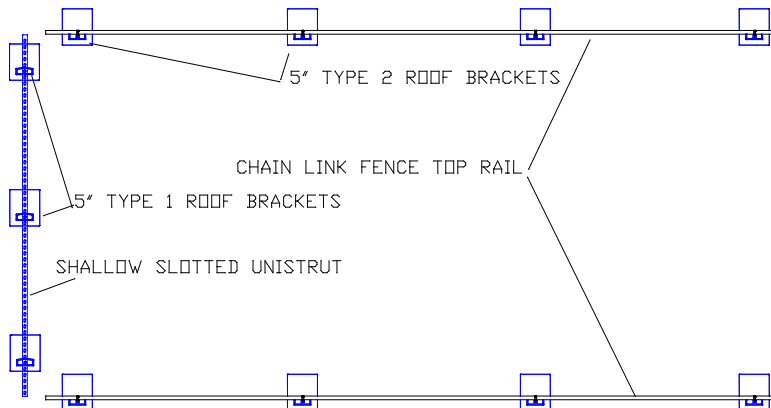
**STAGGERED MANIFOLDS**



Two rows of Unistrut can be mounted using the Hot Sun two bolt 7" roof bracket. The studs are spaced 5" to match staggered manifolds. Staggering the manifolds eliminates all the spaces between fin tubes except the small ones created by the space needed for the zip ties. Staggering also allows for higher flow through the manifolds as you are splitting the flow up between two sets of manifolds. This is advantageous if there are more than 12 manifolds per end. Hot Sun will do your calculations and recommend the appropriate option for your situation. Our go-to design for 12 or less manifolds is inline manifolds because there doesn't end up being much space between fin tube strips. When staggering manifolds, the intermediary pipe will be about 10" long but don't cut these in advance. The fin tubes won't be tight against each other due to the small space required for the nylon ties between fin tube strips. Install the fin tubes first!

Angled manifold assemblies are usually done so there is an even space between the manifolds. This means the manifolds all face the same direction but there is a pvc coupling (glue on with PVC cement) glued to the male end then a short piece of 1.5" pvc pipe glued into the female end of the next manifold. To tighten up this spacing if necessary, you can alternate these manifolds and adjust the length of the 1.5" pipe stub between female ends to match the spacing required. Every situation is a little different so check your fin tube spacing and your manifold spacing before committing fin tubes to manifolds.

**STEP 3) INSTALL THE TOP AND BOTTOM RAILS**





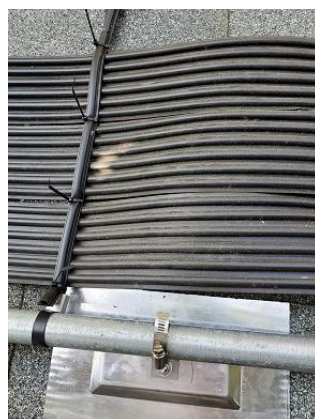
Just beyond the Unistrut plan the top and bottom rails. These frame the collector bank. The roof brackets used here are called 5" type 2 because they have a 1/4" stainless steel stud protruding to accept a strap bracket rather than a 3/8" hot dip galvanized one for Unistrut. Attach a strap bracket and a #20 – 316 ss hose clamp through the strap bracket and loosely around the top and bottom rails. The top and bottom rails are made of 1-3/8" OD chain link fence top rail. Leave the hose clamps loose for now as tightening them later will tighten the straps. Spacing should be less than 6 feet and about one foot from each end.

### STEP 3) INSTALL THE VINYL COATED SS STRAPS



Next run vinyl coated ss strap every 2 feet vertically between the top rail and the bottom rail (1-3/8" OD chain link fence top rails). Secure with strap clamps. Note the lower strap brackets face up the roof and the upper ones face down the roof obviously. Don't forget to seal under the strap bracket with roof and flashing sealant.

You can attach the first manifold to the fin tubes first or just install all the fin tubing and then trim to match the manifolds. Secure the fin tube to the straps by placing a one tube wide piece of fin tubing material over the top and sandwiching the fin tubes using UV rated black zip ties.



Note that instead of the one tube wide strip over the top you could tack the fin tubes to the strap beneath using CA to position everything and finish by gluing with PL but we prefer the nylon tie method because it is forgiving. You can adjust positions as you try to keep the spaces between the fin tube strips even. With the inline manifold method you can achieve consistent even spacing between each fin tube strip. If you alternate the manifolds you will want to have a larger space every 3 fin tube strips because there is a bigger gap between manifold locations (every third fin tube strip).

#### **STEP 4) ATTACH MANIFOLDS TO FIN TUBES ONE END**

Once all the fin tubes are in position cut them to line up with the edge of the Unistrut using your anvil cutters. Then strip the fin tubes into 2 tube wide strips for ease of attachment to the manifolds. Don't glue the manifolds to each other or attach them to the Unistrut before gluing the fin tubes to the manifolds. You need to be able to handle and rotate the manifold to apply the CA evenly around each nipple. Refer to the general installation manual.



If you are staggering the manifolds remember to cut the outside fin tubes first and attach those manifolds, then flip them out of the way and cut the inside fin tubes and then attach those manifolds to avoid errors.

Next plumb the manifolds to each other and secure them to the Unistrut. Heavy body grey pvc cement is recommended on all manifold connections. Primer and PVC cement is recommended on all PVC to PVC connections.

#### **STEP 5) COMPLETE THE BANK**

Arrange all the fin tubing and make sure all the strips are even and straight. Check the spacing between the fin tubes so you are ready to cut the final lengths and attach the manifolds at the far end. Trim the fin tubes and build the other manifold assembly

#### **STEP 6) PLUMBING**

Make sure the weight is taken so the manifold assemblies don't creep down the roof. Perhaps the plumbing itself can support this weight or you can add an angle bracket to the Unistrut at the bottom of the row of manifolds. In most cases the vacuum breaker mounts vertically on the pipe entering the bank off a tee. Horizontal plumbing should be supported every 27". Hanging the plumbing off the lower rail with vinyl coated ss strap and a strap clamp is convenient and doesn't require additional roof penetrations. At elbows at the ends of long runs of PVC pipe remember the piping will expand and contract 1.5 inches over 15 feet so sometimes we use a piece of flexible pvc pipe to make that elbow and sometimes we simply don't secure plumbing that runs vertically allowing the horizontal PVC pipe to move.

Follow the general installation manual, the drawings, and consult with Hot Sun on the specifics for your unique situation. Don't forget to commission the system (check pressure positive and negative)



Hot Sun Industries, Inc.

1440 N Benson Ave Suite D  
Upland CA 91786  
858 683 0800  
[www.h2otsun.com](http://www.h2otsun.com)

### How To Repair a Leaking Powerstrip.

1) Identify the leak and go to the appropriate chapter below. If you are not fully capable of safely going on the roof to inspect the source of the water hire a qualified person. Note water makes roof surfaces slippery. Never go on a roof if it is wet. Never step on a wet solar panel. You can walk on Powerstrips without damaging them but beware they are slippery when wet.

#### CHAPTER 1: PLUMBING FITTING LEAK:

If the leak is a plumbing fitting or a pvc plumbing connection where glued to the male or female end of the Powerstrip header pipe then this can be repaired the same way any pvc plumbing fitting leak can be repaired. Pool stores have collars and 2 part epoxies that are waterproof and made for this kind of thing. A good trick we have used is to seal off the vacuum breaker so it doesn't let air in. By doing this you create a vacuum in the system meaning air is drawn in through the leak. Plug the vacuum breaker hole with a 1/2" threaded plug, run solar, then shut the pump off so water would normally fall back to pool level but it can't because there is no place for air to enter except at the leak. Apply grey pvc cement to the leak and the suction draws the glue into the leak. As the water level in the panels drops the suction decreases and eventually the cement will stop flowing into the leak. Let it dry 24 hours before putting water to it. Look for the cause of the plumbing leak. It could be that the fitting cannot move as the piping it is attached to tries to move with temperature. This in combination with high heat can cause pvc pipe fittings to fail even if glued properly and with primer. Incorporate flexible pvc pipe (spa piping) into the critical areas like the 90 degree bend at the end of a long run of pipe to correct.

#### CHAPTER 2: LEAK IN THE POWERSTRIP FIN TUBE

If there is water coming from the Powerstrip NOT at the header pipe manifold location but somewhere on just the flexible fin tubing the repair is simple and straightforward and does not require drying or draining the system. In fact you don't even necessarily have to shut solar off to do this. Just buy some 1/4" PVC drip irrigation tubing at Home Depot.



Make sure it is vinyl or PVC (same thing) and not polypropylene or polyethylene. It measures 9/32"OD and the ID isn't much smaller than the Powerstrip fin tubing ID (inside diameter).

Simply cut the fin tube where the leak has occurred and splice it back together with about 1.5" of the drip irrigation tubing. Simply apply CA (cyanoacrylate) adhesive to the splicer all the way around and shove it into the fin tube. It dries instantly and can be done wet. Moisture is actually what cures the adhesive. Hot Sun supplies CA adhesive to join headers to fin tubing. It's a mid viscosity blend. You can buy Krazy glue gel or SuperGlue gel in 3ml tubes and that's enough for a few splices. You can also now buy Gorilla Superglue at Home Depot. Its 0.71 oz and its enough for about 20 splices. Be careful with CA adhesive. Don't breathe the fumes and don't get the fumes in your eyes. Don't hold the connection tight after gluing because you could find your finger glued to the solar panel. Acetone is the solvent for CA adhesives.



Gorilla CA adhesive

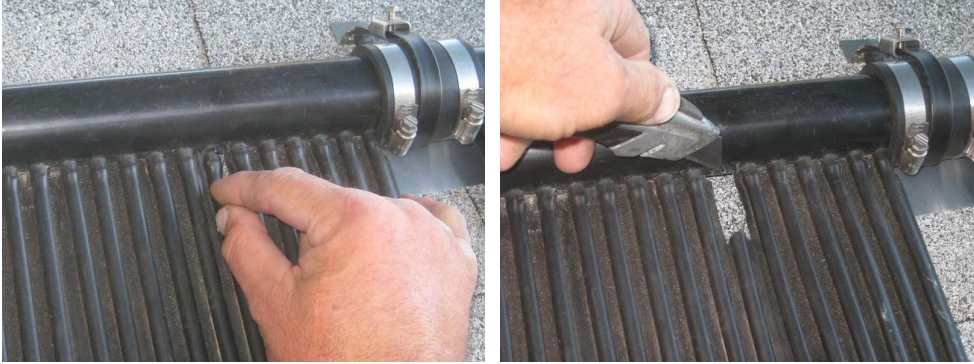


Hot Sun CA adhesive

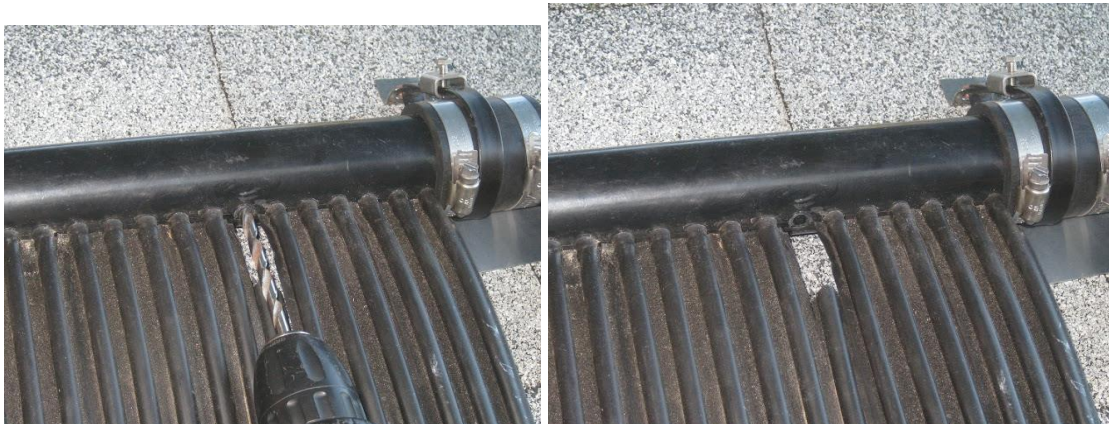
If you have a split in the fin tubing this can be caused by the collector collapsing when going under suction pressure. Watch the system as it is turned off to see if the fin tubes are collapsing. To prevent this add a vacuum breaker on the return side at the top. Fix any

leaks as above and the problem should not get worse. Cracks along the surface not causing a leak should not get worse over time if the tubes are not stressed by repeated collapsing and inflating over and over over years.

### CHAPTER 3: BROKEN NIPPLE AT HEADER



If it gets stepped on or impacted hard the nipple coming out of the header can break. Push on it to see if it is separated from the header. If that is the leak remove that nipple. Break it right off and cut the fin tubing off as close to the end of the broken nipple as possible.



Drill a hole to match the size of the replacement nipple. Hot Sun can supply 1/4" OD black rigid pvc nipples. Don't use the drip irrigation splice material. Its too flexible. Hot Sun can mail these nipples anywhere on the planet. Our service and support extends only to the planet earth.

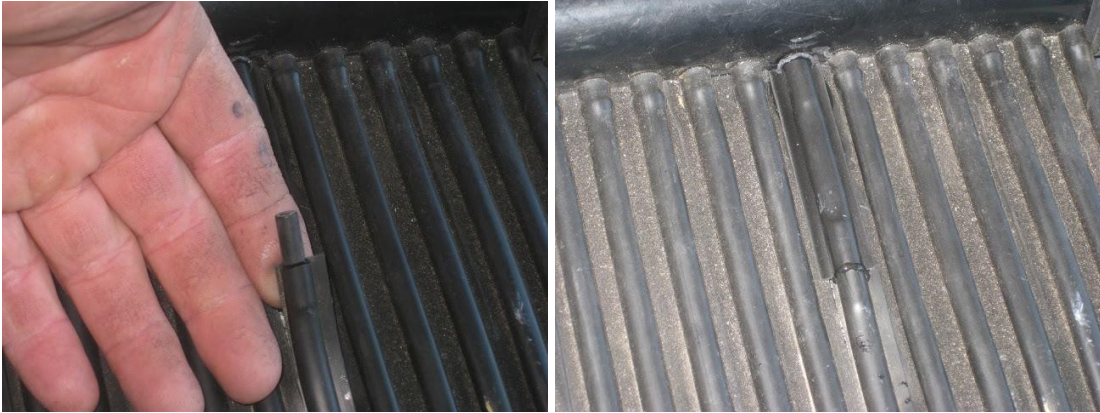


Glue the repair nipple into the hole using pvc cement on a Q- tip. Apply pvc primer and cement as always to both parts first all the way around. Twist as you insert and don't stress it after its been inserted until its had a chance to set up.



Next glue the loose fin tube that you cut close to the original nipple right onto the repair nipple the same way you would a brand new header. Use CA adhesive from us or Gorilla brand super glue (Home Depot) or Crazy glue gel or Superglue gel) Apply CA only to the nipple not the inside of the fin tube. Push fin tube on and you're done. There will be a

gap where the fin tube was cut short. If you don't like the gap cut the fin tube back and do an extra splice as shown in the photos. Note the splice is PVC drip irrigation tubing. Drip irrigation tubing is great for splicing fin tube to fin tube because its larger ID so it doesn't restrict flow and its only semi rigid. The repair nipple does work as a splicer but not the other way around.



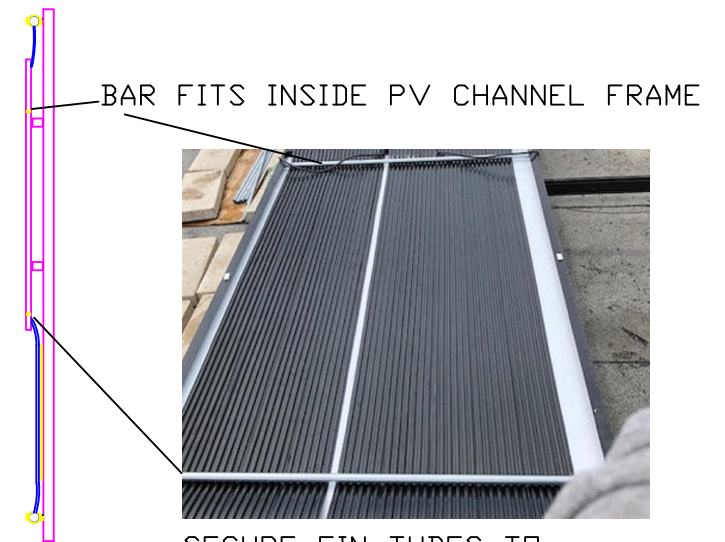
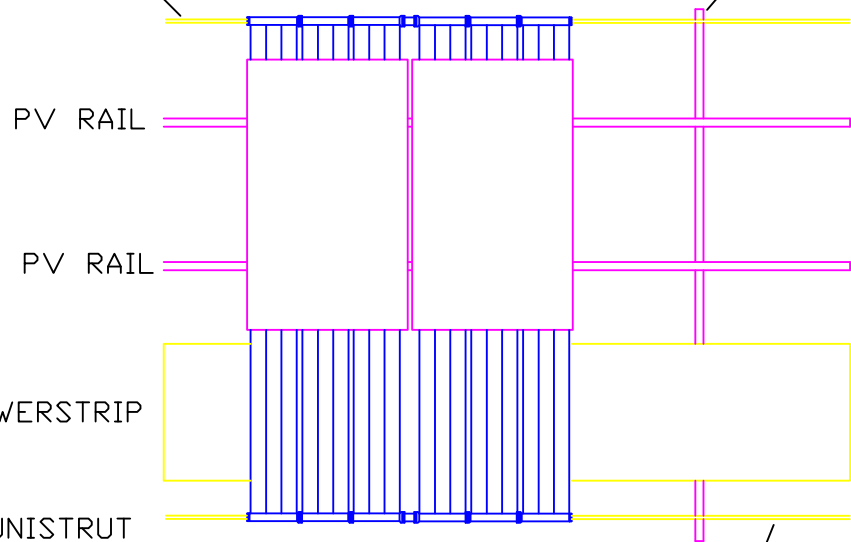
#### 4) MAJOR HEADER PIPE DAMAGE

If the system froze solid with water in it or has suffered cracking then you have to replace the whole header. New modern mounting methodology involves securing manifolds top and bottom or left and right meaning you can stretch the fin tubes and force the system into the slightly smaller size. Every case is a little different. Please consult with Hot Sun as needed.

SHALLOW SLOTTED UNISTRUT

ALTERNATE EVERY 3 HEADERS  
3 SECTIONS PER 1M WIDE PV

EXTEND PV RAIL SUPPORTS  
TO CAPTURE UNISTRUT



SUPPORT BACK OF POWERSTRIP

HOSE CLAMP SLIDERS ON OUTSIDE  
OF BELL ENDS, ONE PER HEADER

TILT UNISTRUT SLIGHTLY  
FOR AIR RELEASE  
ON TOP HEADERS AND  
DRAINAGE ON BOTTOM HEADERS



HOT SUN INDUSTRIES LTD. Burnaby BC Canada 778-300-1803		PVT LANDSCAPE SINGLE ROW	
		ECH/SC	NO. DESSIN / DWG NO.
DATE			GR/SIZE
PAR/BY	KEN WRIGHT		
VER/CHK			



Distributed and serviced in the USA by  
Hot Sun Industries Inc  
1440 N. Benson Ave Unit D  
Upland CA 91786  
858-683 0800  
e-mail: ken@h2otsun.com  
web site: <http://www.h2otsun.com>

## TILE ROOF INSTALLATION MANUAL ADDENDUM

Refer to the drawing "TILE1000"



© 2019 copyright Hot Sun Industries Inc (USA) and Hot Sun Industries Ltd (Canada) All rights reserved

**WEAR EYE PROTECTION AND GLOVES WHEN WORKING WITH THE CA ADHESIVE. FOLLOW PROPER SAFETY PROCEDURES WORKING ON A ROOF. DO NOT ATTEMPT THIS WORK IF YOU ARE NOT TRAINED AND CERTIFIED IN FALL PROTECTION. REFER TO THE HOT SUN GENERAL INSTALLATION MANUAL.**

The biggest mistake people make is gluing the manifolds to each other (PVC CEMENT) and doing that plumbing before gluing the fin tubes to those manifolds. ALWAYS glue fin tubes to manifolds (using CA adhesive) before gluing or connecting manifolds to each other.

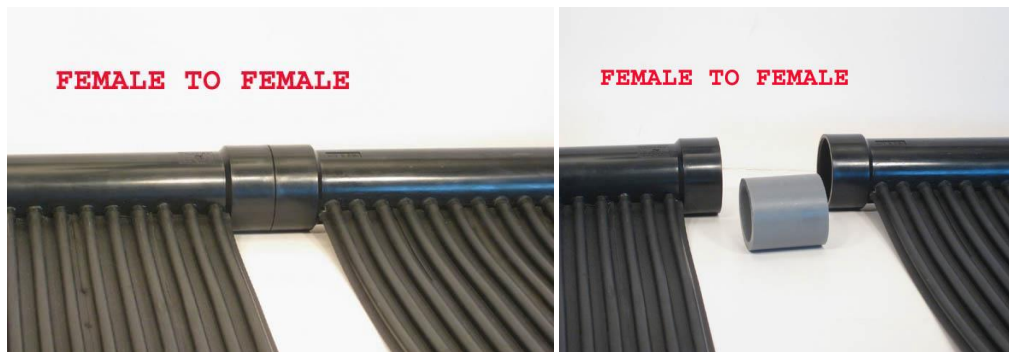
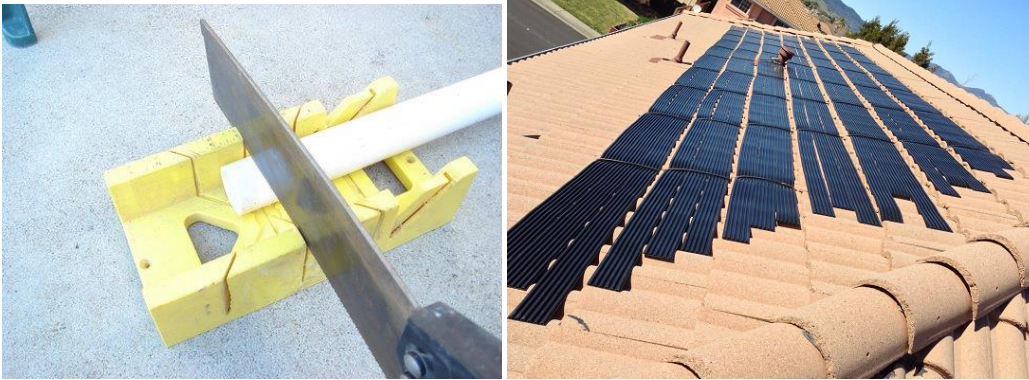
This manual only discusses the methods unique to tile roofs.



Tile roof installations can not be prefabbed. Take care gluing the fin tubes to the manifolds with the CA adhesive. It is important to fully wet the entire surface of the nipples before slipping the fin tubes on 2 tubes at a time. Strip the 6 tube wide fin tubes near the end so that you can work with 2 tubes at a time.

## OVERVIEW:

The fin tubing comes in 88 foot lengths, 3.75 inches in width, including 6 water flow tubes. Three of these strips of the fin tubing fit on one row of tile. A single manifold corresponds to the same one row of tile. A header manifold is 13.5 inches long. In most cases headers will alternate meaning the male ends are connected via couplings (PVC glue-on) and the female ends are connected via lengths of 1.5" pvc pipe. These lengths are determined by the tile row spacing.



REMOVABLE COUPLING SHOWN BUT WE ALMOST ALWAYS GLUE THEM WITH PVC COUPLINGS. Why? Because this way you can never empty the pool onto the roof!

If your tile spacing is tighter than 13.5" you can steal an extra inch by gluing the male end to the female end of two adjacent headers. Read the main installation manual for instructions on the use of PVC cement. We recommend heavy body grey PVC cement for the PVC pipe connections to the headers (no primer). See general installation manual. Apply pvc cement

evenly to female and male ends and slide together with ¼ rotation.

## STEP BY STEP

### 1.0 PLANNING:

You are working with 88 foot lengths so average them out to be less than ½, or 1/3 or 1/4 of 88' and you won't waste any material.

## 2.0 FIN TUBES TO ROOF:

Roll out the 3 fin tubing strips and begin gluing them to the roof starting with PL about a foot from that first manifold. Don't walk backwards on a roof! If you put the fin tubing on the manifold first you have less waste but it's a lot easier to install all the fin tubes first and then trim the fin tubes to match the exact manifold location. Gluing the fin tubing to the roof is done with Loctite (or Lepages) PL Premium 3x (PL). This mastic is runny and things may slide around while the mastic sets up. Depending on air temperature this can take days. If the roof is steep enough that gravity takes over and things won't stay in place alternate with beads of Loctite |Powergrab (we call it PG). Glue down every crest of every tile or every 12"-16" side to side. Use one single continuous bead. PG is tacky and sticks and holds things in place initially while the alternating bead of PL can set up. PG is poor structurally so think of it as the tack and PL as the structural. Let it dry a day before attaching the manifolds. It's a lot easier to control the smaller 12 oz cartridge size tubes and avoid runout between shots.

An alternate (and much easier) method is to stitch the fin tubes to the roof. Stitching allows you to avoid adhesive entirely or add the adhesive later. Florida hurricane code requires the use of PL every 8" side to side but this is overkill for non-hurricane zones. The stitching strip is made by separating one or two tubes of Powerstrip material. It tears along a perforation once started.



Cut fin tubes with an anvil style cutter. Be careful not to nick the tubing away from where you are cutting. You can cut all 6 tubes in one snip.



Use regular solid black vinyl coated electrical wire (12 gage). Cut pieces about 8" long, bend one end 90 degrees, lift tile with a screwdriver, slide the bent end between tiles until you can rotate the wire 90 degrees so it grabs the top of the tile below. This wire can secure the one or two tube wide strip. Use needle nose pliers to bend the wire. This positions and secures all the fin tubing. You can glue it all down later for best

wind resistance. Stitch vertically every row of tiles and horizontally at least every second trough. If you stitch every trough you will get a more consistent wave matching the tiles.

### MANIFOLDS

Know exactly where your manifolds are going before trimming the fin tube and gluing it to the manifolds (using CA). This row of manifolds will sit in a trough. Its very important that the fin tubes come off the manifolds at the same angle and that the fin tubes don't touch the roof next to the manifolds. The manifold assembly will expand and contract with temperature and this movement against the tile will wear the fin tubing and a leak will develop if the fin tube is in contact with the tile. The manifolds and plumbing can rub on the tiles without concern.

It is important to attach fin tubes to headers before connecting manifolds together. You have to inspect the wetted nipples from all angles and you can't do that if the header is glued in place first.

Take the weight of the headers. If the plumbing is secured properly and close to the solar panel array that will often support the weight of the manifolds themselves so they don't creep down the roof.

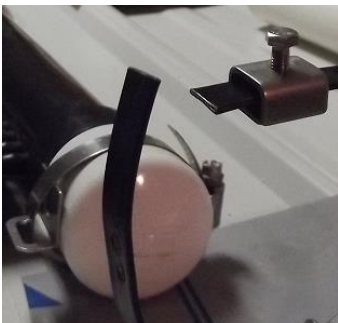


If necessary another method is to slip vinyl coated ss strap through a strap bracket as shown above left. Then just slip it between tiles (lift tiles with a screwdriver) so it catches in the space above the tile.

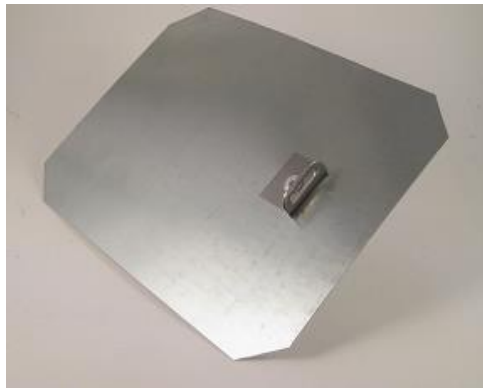
There is wood under the ridge caps that can be used to secure a vinyl coated ss strap (shown above)

A strap bracket riveted to a plate (same hardware to secure the manifolds) glued between tiles using PL can be used as well. A loop of vinyl coated ss strap goes around the manifold and the loop is completed with a strap clamp. Use a strap bracket attached to the

manifold with a hose clamp to secure the strap connection point.



Secure every second manifold to the roof using the same strap bracket riveted to a stainless steel or painted galvanized steel. Also secure at ends of manifold assemblies. If not gluing the plates between tiles (PL) roughen the surface of the metal with sandpaper for better adhesion. If the vinyl coated ss strap position is not perpendicular to the manifold connection secure it with a strap bracket and hose clamp.



### ANGLED MANIFOLDS

Separating into individual tubes at the ends and attaching each tube individually to the header allows you to angle the headers. The headers do not need to be perpendicular to the flow!



If the manifolds are angled it means there is more space between manifolds. You'll need a glue-on PVC coupling for each male end to PVC pipe or you can alternate the directions where male ends are connected via pvc couplings and female ends are glued together via varying lengths of pvc pipe to line manifolds up so they correspond to the fin tubes row by tile row. For more on corners and angled headers refer to the general installation manual. SEE drawing TILE1000

## FINISHING



Assemble the manifolds at the other end to the fin tubes first, then to each other and secure to the roof using the same methods described. It's very important you don't try to glue the headers to each other first. . A chalk line can be helpful. Pay close attention that the fin tube doesn't shift. The glue (PL and PG) take a while to dry.

Complete the stitching to the roof or the gluing with alternating beads of PL and PG as described earlier (or both). The straps go every trough which is approximately every foot and stitch to the roof at every single row of tiles. Its one stitch for every square foot. You might want to complete the plumbing first and run water thru the system to keep the surface cool as you crawl around on it. Hot Sun collectors can be very hot in hot sun.

## PLUMBING

Always paint any piping exposed to the sun. We recommend paint that comes in a can as opposed to spray paint. Acrylic based paint is best for pvc. Painting the manifolds further protects them from the sun. Make sure all the PVC cement is dry before painting.

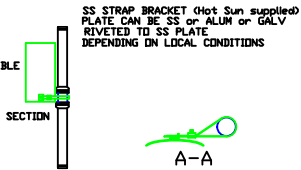


The vacuum breaker should be teed off the pipe entering the bottom corner of the bank of collectors. Use Teflon tape on the 1/2" threaded connection. Wrap the Teflon tape around the threads 5 times clockwise. The vacuum breaker sits vertically.

Provide a means to drain the bottom dead corner. See drawing TILE1000

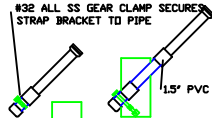
Refer to the general installation instructions for plumbing and start up.

ADJUST LENGTHS OF PVC PIPE SO HEADERS LINE UP WITH EACH COURSE OF TILE  
WHEN INSTALLING FIN TUBING LEAVE ENDS OF TILES VISIBLE FROM GROUND LEVEL FOR ESTHETICS



1.5" REMOVABLE COUPLING (Hot Sun supplied)  
USE REMOVABLE COUPLINGS OR 1.5" PVC COUPLINGS AT MALE TO MALE CONNECTIONS. LOCATE CONNECTION POINTS AT REMOVABLE COUPLING. IF USING PVC COUPLINGS LOCATE CONNECTION POINTS AT PIPE BETWEEN FEMALE HEADER ENDS.

SS STRAP BRACKET (Hot Sun supplied)  
PLATE CAN BE SS or ALUM or GALV  
RIVETED TO SS PLATE  
DEPENDING ON LOCAL CONDITIONS

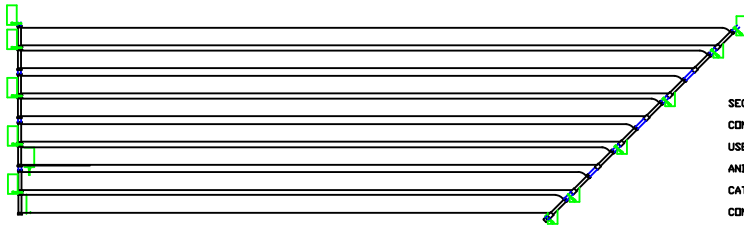


1.5" PVC COUPLING

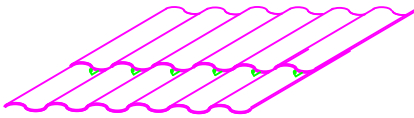
PPA COATED SS STRAP (Hot Sun supplied)

HOT SUN HEADER MANIFOLD GLUES TO PVC SAME AS PVC PIPE. THIS MANIFOLD IS STYRENE. IT REACTS WITH PVC CEMENT AGGRESSIVELY. LET JOINTS DRY WITH PLUMBING OPEN 24 HOURS BEFORE SEALING IT UP OR PUMPING WATER THROUGH

BEND RIVETTED PLATES TO CONFORM TO TILE  
LIFT TILES WITH PRY BAR OR SCREWDRIVER  
SLIP RIVETTED PLATES UP BETWEEN TILES  
AND APPLY LEPAGES PREMIUM ADVANCED  
CONSTRUCTION MASTIC TOP AND BOTTOM TO  
LOCK TILES TOGETHER AND SECURE PLATE TO ROOF

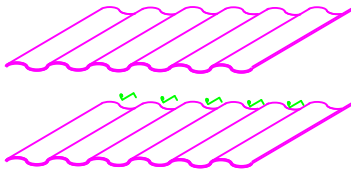
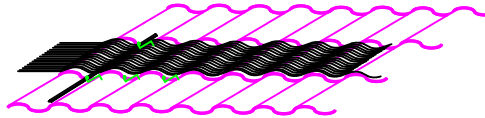


SECURE FIN TUBING TO ROOF AT EACH TROUGH IN TILES SUCH THAT EACH CONNECTION POINT SECURES NO MORE THAN 1.2 SQUARE FEET OF FIN TUBING.  
USE A 7' LENGTH OF 12GA SOLID COPPER WIRE BENT AT ONE END. LIFT TILE AND INSERT BENT END AND ROTATE 90 DEGREES SO BENT END IS DIRECTED DOWN CATCHING ON UPPER EDGE OF TILE BELOW. APPLY LEPAGES PL PREMIUM ADVANCED CONSTRUCTION MASTIC BETWEEN TILES AT THESE CONNECTION POINTS TO LOCK TILES TOGETHER.



7' LONG PIECE OF 12 GA COPPER WIRE, BLACK PVC COATED

TIE ONE TUBE WIDE POWERSTRIP MATERIAL AT TROUGHS IN TILES



HOT SUN INDUSTRIES LTD. Burnaby BC Canada 778-300-1803		POWERSTRIP PSG 135	
TILE ROOF MOUNT SOLAR POOL HEATER			
ECH/SC		NO. DESSIN / DWG NO.	GR/SIZE
DATE			
PAR/BY	KEN WRIGHT		
VER/CHK			



Hot Sun Industries, Inc.

1440 N Benson Ave Suite D  
Upland CA 91786  
858 683 0800  
[www.h2otsun.com](http://www.h2otsun.com)

## 15 YEAR LIMITED WARRANTY

Hot Sun Industries Inc., (Hot Sun) expressly warrants POWERSTRIP solar collectors to be free from defects in materials and workmanship for a period of fifteen (15) years subject to the following limitations, terms, and conditions.

The POWERSTRIP solar collector consists of 13.5” long manifolds and 3.75” wide flexible fin tubing strips. The two parts are assembled by the installation contractor as part of the supply and installation contract between the dealer and the homeowner. Hot Sun’s liability is limited to replacement of the fin tubes and manifolds. Hot Sun is not liable for the cost of shipping or labor to make repairs or install replacement materials.

Warranty claims must be filed directly with Hot Sun and the decision as to warrantability shall be at the sole discretion of Hot Sun.

- 1) Hot Sun warrants that . when installed in accordance with the Powerstrip installation instructions, Powerstrip solar collectors will not develop leaks due to:
  - a) freezing (if properly winterized). The fin tubing is guaranteed even if left full of water through freezing conditions but rigid piping and manifolds will crack if frozen fully or partly full of water. It is the homeowner’s responsibility to make sure the system drains properly and adequately. Winterizing contracts can be negotiated with the installation contractor. It is important to note that solar collectors for swimming pool heating freeze on clear nights at 42F not 32F.
  - b) degradation due to exposure to sun or
  - c) swimming pool chemicals or any other typical pool chemicals other than ozone. Ozone is known to break down this type of material so if the pool has an ozone generator solar must be returned upstream. North American ozone systems for pools do not create an ozone residual in pools that can be harmful to solar panels.
- 2) The warranty period of 15 years shall begin on the contract installation invoice date from the independent installation contractor. Installation contractors are independent. Hot Sun assumes no liability for work that falls under the said contract. Even if Hot Sun refers or recommends a contractor this shall not be

taken as a declaration of association whereby Hot Sun assumes any liability whatsoever other than the product itself. Hot Sun's liability on materials replacement shall be prorated as follows. Year 1 to year 5: Hot Sun will cover 100% and the homeowner will pay 0% of the cost of Powerstrip materials replaced. Year 6 to year 10, Hot Sun will cover 50% and year 11 to 15 Hot Sun will cover 25%.

- 3) In no event shall Hot Sun be liable for :
- a) Damage caused by failure or movement of the surface the solar collector is mounted to,
  - b) Any products or parts other than the POWERSTRIP solar collector as described above
  - c) Lack of performance of the solar collector. Many factors affect the performance of a solar heater including weather. If you feel it and it is operating at pool temperature without hot spots then it is operating efficiently
  - d) Damage by acts of God, wind hail, fire, or anything else normally covered by homeowner's insurance
  - e) Consequential damage including but not limited to damage to property occasioned by the installation of the solar collector.
  - f) Changes in the mechanical situation the solar system was originally designed and commissioned for. Specifically this is in regard to pressure. If changes are made the owner must ensure that the pressure the solar collector operates under remains less than 5 psi including the pressure pulse often seen on start up as the initial air is forced down the return pipe to the pool.
  - g) Suction pressure can be damaging. The homeowner must ensure the fin tubes do not collapse when the solar system is turned off. Repeated collapse and inflation of the fin tubes repeatedly over years can cause fatigue stress cracking and failure of the fin tubing. A change in vacuum breaker placement can remedy this problem if it occurs. Subtle changes to pump speed, operating schedule, etc can affect the mechanical situation the solar system must operate in. It is recommended that every year a qualified solar service technician is hired to check the system for excessive pressure or suction issues.
  - h) Variable speed pumps allow for 3050 operating points reaching right up to the equivalent of 3HP. A 3HP pump on a pool is extremely excessive and potentially damaging to solar collectors. Factory priming speeds are set to maximum to ensure the pumps do not lose prime in worst case scenarios (the pump located 10 feet above the pool for example). Priming speeds on pumps must be set as low as possible so that solar heaters do not see excessive pressures.
  - i) Adhesives or balance of system components. The adhesives we specify work. If there is a failure of an adhesive it usually has something to do with an extreme act of God or a surface adhered to and does not amount to Powerstrip components damage.

4)

Its important to note that solar pool heaters are plumbing. Our systems are designed to be treated as an extension of your pool's plumbing. If there is an

issue the parts are inexpensive and the system is designed to be very serviceable. Competing grid style panel systems must be replaced in their entirety (panel by panel) if there is a problem. Hot Sun's system is designed with serviceability in mind.

