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## **GENERAL INSTALLATION MANUAL**

**see manual addendums for specific roof types**

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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.

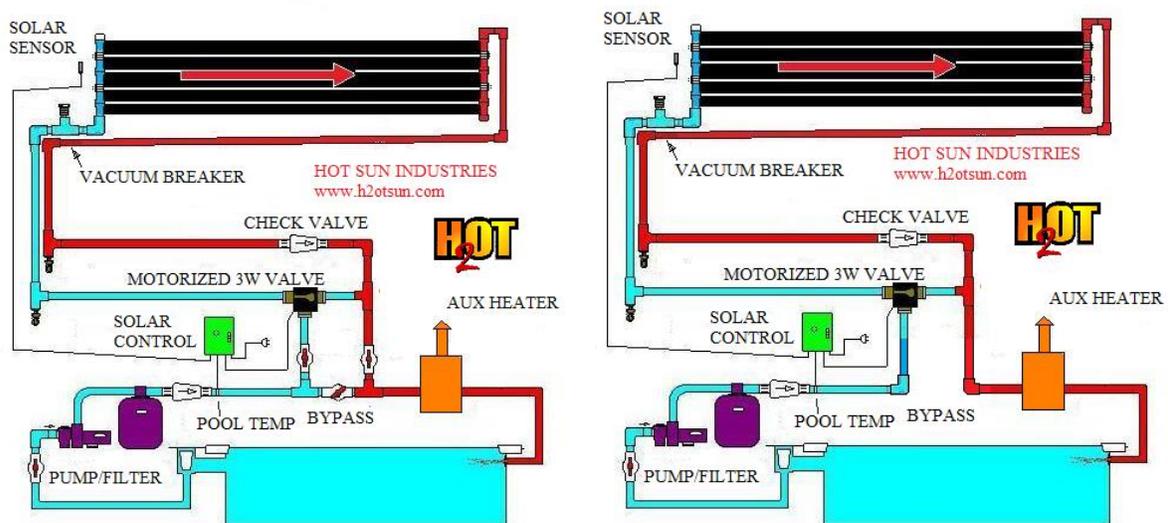
### **2.0 POOL SYSTEM COMPATIBILITY**

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.

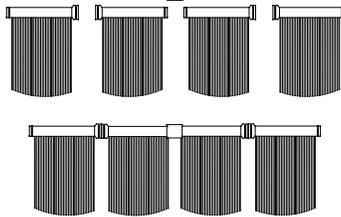
Always glue the manifolds to the fin tubes before attaching the manifolds to each other or mounting them., Start at one side and finish that side. Straighten it out and then use a chalk line to mark the opposite end. Then cut to length and attach the opposite end's header manifolds. Don't assemble all 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.

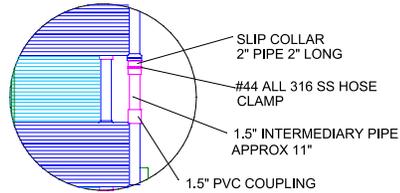
ALTERNATING MANIFOLDS - MALE TO MALE VIA PVC COUPLING  
FEMALE TO FEMALE VIA PIPE STUB



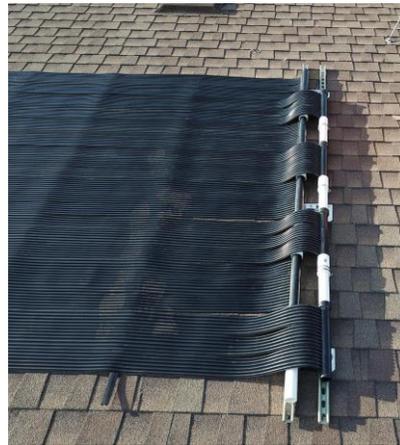
When we alternate the headers we are using a single row of manifolds. We create a space between fin tube sets ( each fin tube is 6 tubes 3.75" wide. 3 of these per manifold is a set). The space allows for air pressure release and sometimes it is advantageous to also allow the roof to breathe.



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.

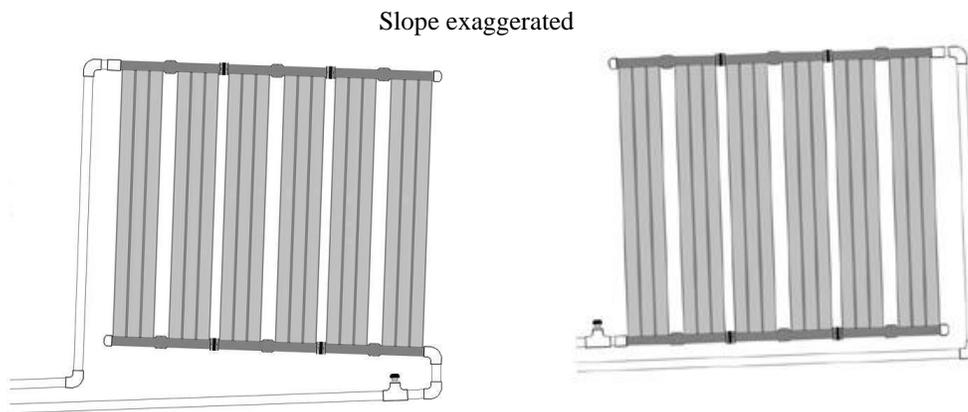


Fig. 2: Sloping panel banks and roof piping

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



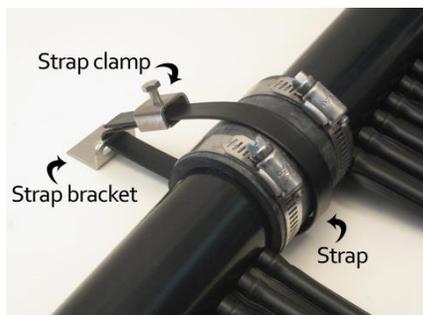
Sideways with staggered headers

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



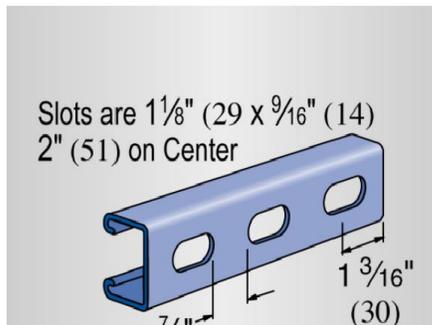
Flashing

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

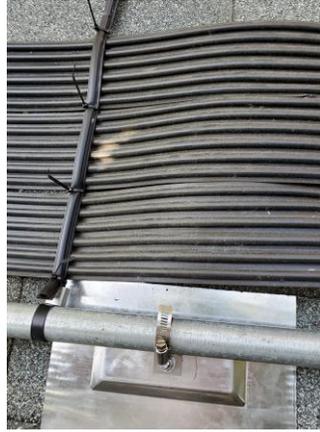
Seal any roof penetrations and where threaded studs come through flashings with black polyurethane roof and flashing sealant as shown above

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

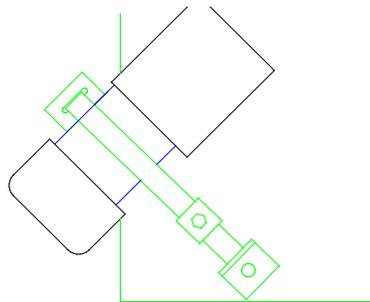
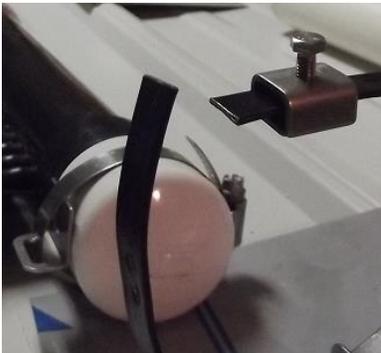


PL construction mastic

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.

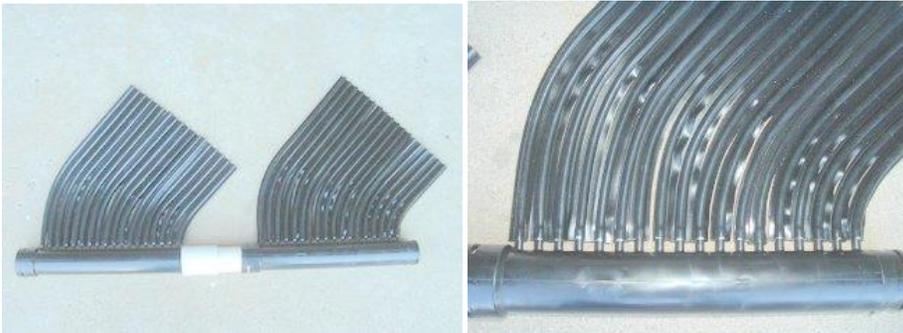


An useful trick to keep a strap from coming off or cutting into adjacent fin tubes as the manifolds change length with temperature is to loop the strap through a strap bracket that is hose clamped to the manifold or end cap.

## 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.



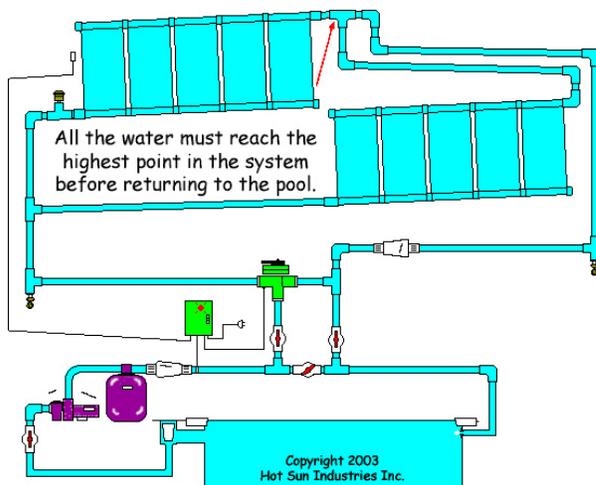
Test it out before you commit. It depends on roof pitch and angles and visibility. Sometimes you can just take the corner without adjusting the fin tubes at all. Often separating into 3 tube wide strips just at the corners is workable. It all depends on the slopes and angles and the visibility from ground 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 ¼ 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 ¼" 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)