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.

IMPORTANT TECHNICAL 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 42°F 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 8 psi) 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 8 psi). 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.

TABLE OF CONTENTS

1.0 SAFETY

2.0 OPERATION
   2.1 WINTERIZING
   2.2 INITIAL START UP

3.0 PLANNING THE JOB

4.0 INSTALLATION
   4.1 ASSEMBLING MANIFOLDS TO FIN TUBES
   4.2 ALTERNATING OR STAGGERED HEADERS?
   4.3 CONVENTIONAL OR SIDEWAYS CONFIGURATION?
      4.2.1 CONVENTIONAL
4.2.2 SIDEWAYS
4.4 COLLECTOR MOUNTINGS
        4.4.1 ADHESIVE MOUNTING
4.5 ANGLED HEADERS
4.6 GOING AROUND CORNERS

5.0 PLUMBING

6.0 PRESSURE FLOW AND POWER CONSIDERATIONS

7.0 TROUBLESHOOTING and REPAIR

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 that joins the fin tubes to the headers is cyanoacrylate aka superglue. The fumes will burn your eyes and the adhesive 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 OPERATION:

Typically residential solar pool heaters are controlled by a motorized valve, automatically controlled by a differential thermostat that may or may not be part of the swimming pool control system. 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 infloor 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.

Our recommended typical solar tie in uses a 3 valve bypass arrangement as shown in Figure 1a. 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. If the pressure is high Hot Sun can help devise a configuration something like Figure 1b. Ideally we don’t want to have to change the pool filtration in order to control pressure but often there are grounds to do just that. If changing to a variable speed pump can save ten fold on costs, reduce noise, and allow better vacuuming then maybe its worth considering.
Fig 1a: General Schematic of Solar Pool Heater- low pressure design on left and a common high pressure design (Fig 1b) on right.

The diagrams above show typical plumbing schemes for automatically controlled solar pool heaters. When the roof 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) though 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 water level drops.

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 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 BV1 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. Adding the extra solar plumbing can mean we can over work a pool pump unless we’re careful not to try to force too much flow though too much pipe restriction. 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.

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. Common 3 way valves in the pool industry can accept motors as a bolt-on addition later so there’s no harm in starting with a manually controlled solar heater and automating it later if desired. Manual control is commonly chosen when the pump can be put on a timer to only operate during the hours of the day when direct sun is on the solar panels. If the filtering and other pool functions can coincide with that same pump run time then a timer and manual control allow the system to be operated with minimal inconvenience. You will cool the pool when running water through the solar panels in the wrong conditions.

The vacuum breaker (VB) is on the pipe going into the collector(s) even if the collector orientation is sideways. We're trying to have some restriction (head) downstream of the VB so it doesn't open allowing air in during operation. Air makes noise and the VB will not last if it is oscillating constantly. The vacuum
breaker prevents negative pressure. If it is sucking air it means the pressure is below zero. If you are getting air bubbles into the pool when solar is on it probably means you need to increase flow to cause some restriction to flow thru the solar piping. It also often means its time to backwash or clean the filter. The vacuum breaker must be close to the inlet manifold and the system characteristics must be such that the fin tubing of the solar collector does not collapse under vacuum pressures preventing the vacuum breaker from functioning. See Start Up Instructions.

2.1 WINTERIZING:

All the plumbing must slope downhill toward the drains. Simply shut off the pump and wait for most of the water to drain down to the pool. Note the 3-way valve seals and also the check valves don't let water drain past them backwards. Open the drains and isolation ball valves and turn the three way valve to let water past it and wait. Then close the isolation ball valves. Don’t trap water inside the ball valves. Spring start up is the reverse. Don’t turn the pump on with either of the two isolation ball valves (BV2, BV3) closed unless BV1 is fully open. The collector tubing is flexible. It can expand as water freezes inside it without a problem. The manifolds (headers) are rigid. The jargon is sloppy. A manifold is called a header whether its at the top or bottom (conventional orientation) or left side or right side (sideways orientation). You have to prevent manifolds from freezing with water in them by draining them manually or by sloping the headers and attached plumbing downhill back to the pool or a drain point. Leave the drains in the pump area open in case an isolation ball valve leaks. Close the drains on the roof to make sure water doesn’t get back in. Its important to understand that water inside a black solar collector will freeze when air temperature on a clear night is 42F not 32F. This is why it is crucial that solar collectors be flexible. You don’t have to worry about freezing until your piping and solar header manifolds are in danger of freezing solid.

2.2 INITIAL SYSTEM START-UP (COMMISSIONING)--- VERY IMPORTANT DO NOT IGNORE

It is very important to check system pressures on a new solar heater especially if we figured the system pressure was low relative to the roof height and we’re using Figure 1a (left). Close the drains, open the 2 isolation valves (BV2 and BV3) fully and turn the 3-way valve (3w) to direct flow to the solar panels. Leave the bypass valve (BV1) fully open for now. If it is an automatic solar system and it’s not sunny enough to activate solar then switch the valve manually using the controller. The 3 way valve turns to send flow to solar but nothing happens at this stage because the bypass valve is fully open so all the flow goes to the pool and none to solar. The system will fill to some level corresponding to whatever the pressure is. Not exactly because you’ve created a compressed bubble of air but let’s not get too technical. Slowly close the bypass valve 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 gage 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 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. We want to help you correct it now because if we don’t, it spells potential problems later. 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 bottom line is DO NOT PRESSURIZE SOLAR PANELS! The lower the pressure on the solar panels the better. Note: It is important that the solar off pressure is zero. If it isn’t you will have a larger pressure spike as the system starts up and your solar on pressure will be too high and it will be difficult to control. See www.h2otsun.com/pools for more on getting that solar off pressure down to zero. 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. We can allow a solar off pressure of 5 psi as well.

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.

**If the design is a pressure design as in Fig 1b then restrict BV1 to limit the flow to solar.** It's possible but unlikely that with BV1 fully open you will have pressure in the solar panels. The more you close BV1 the more you send flow to the pool through the other leg, the one with the gas heater on it if there is one. High flow is best for solar because high flow means a colder average collector temp and cold and black is what we want for best efficiency. However, we can get away with quite a low flow in a pressure regulated solar design (Fig 1b). If the water trickles out hot after the initial slug of hot water then you need more flow. If high flow is adding pressure then flow is too high. There is a big range in between.

Note: You probably have a variable speed pump if you live in this century. Luckily there is a big range of flows that will be compatible with solar but you have to be cognizant of solar pressure. If you crank the speed up for vacuuming you should check solar pressure in that condition with solar flow on and off. Make sure all your pump speeds and operating modes don’t overpressure solar and if they do reconsider the speed settings (because they are probably excessive anyway) and consult with us. Variable speed pumps usually have a start up speed that is quite high. This ensures the pump will prime in every case but this case isn’t every case. Its one case and if the pump isn’t far above pool level it won’t take much to start the pump. You usually want to turn that start up speed way down to avoid stressing equipment especially solar. You may have to time solar off with vacuuming or pool cleaning functions. Operating the spa in a pool spa combo using motorized valves maintaining spa temperature high relative to pool temperature at all times can make for very challenging solar compatibility. In floor cleaning pop up style automatic cleaners require high pressure and can render solar designs more challenging. The more you try to do with computer controlled pool automation the more challenging adding solar can be. Its important to fully understand the pool functions so that you can make sure solar is not over-pressured in any operating condition.

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 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 affect 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. Pipe can change length by 6 inches over 30 feet.

**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). Repeat visual check yearly.
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.
3.0: 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. 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 ½ roll (44 feet) or ¼ 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. Get us a roof plan. We can help.

4.0 INSTALLATION

4.1 ASSEMBLING MANIFOLDS TO FIN TUBING:

Note: We sometimes call the manifolds at the top, the top headers and the manifolds at the bottom the bottom headers rather than calling them headers and footers.

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

Use the supplied special CA adhesive (CA means cyanoacrylate – Superglue and Krazy Glue are CA adhesives but they don’t work. They are too thin) 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.
Simply apply the special 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.

To aid in the assembly it is helpful to build a simple vice to hold the header. This makes it easier and keeps the special adhesive off your hand so you don’t stick yourself to the header. The vice also allows you to work with the fin tubing with two hands. With experience we have found the vice is not needed.

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

Special adhesive

Make sure the entire nipple surface area is fully wetted before sliding the tubing on. A Q-tip (optional) aids in spreading the special adhesive evenly when using the vice. Alternatively 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. You can usually wet all 18 nipples and then push the nipples on 2 at a time. If the special adhesive skins over or dries, reapply. Always wear eye protection and gloves. 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.
If you do make a mistake and have a leak a great trick is to replace the vacuum breaker with a plug, run solar, then shut off pump. Air will be drawn into the leak and you can use this to suck pvc cement or the same special adhesive into the joint. With a minor amount of care its unlikely any of your connections will leak. See the repair manual if needed.

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 headers 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 how that you’ve fully wetted the nipples with the special CA adhesive. Its very important you don’t miss a spot. The seal requires the glue makes the seal. Its not a stretch fit.

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

4.2 ALTERNATING OR STAGGERED HEADERS

Alternating means we alternate the direction each header pipe faces using a rubber removable coupling or glue on pvc coupling on the male to male connections and a 2” long stub of 1.5” PVC pipe glued between the female ends.
Strap bracket and gear clamp contains White glue on pvc coupling shown male to male strap so it can’t slide off at end caps.

The headers have a male and a female end. Make sure everything is clean first but don’t use primer on the manifolds. We don’t generally use primer even with 2 part PVC cements (ones that require the use of primers) because our header material isn’t PVC. Its ASA and ASA reacts with MEK (the active ingredient in PVC cement and primer) very aggressively. In fact this can be an issue. You don’t want to seal the header plumbing assembly up with wet pvc cement inside. You ideally want to let it air out for a day before sealing up the final connections otherwise the MEK can continue to attack the ASA to the point failures can occur. Follow instructions and heed safety warnings on the cans. Primer if recommended for the PVC cement being used should be used on all pvc to pvc connections but...its nasty. Its very thin and can splash in your eyes. It really burns any open cuts and it’s a known carcinogen so yeah it melts the pipe and makes a better connection but there’s little pressure in this application. Don’t use clear PVC cement because you can’t tell if your joint is complete. You’re going to paint it all so there is no advantage to clear. Join female ends together using lengths of 1.5” pvc pipe. Bevel the cut ends so they don’t squeegie the pvc cement off. Do not stress this joint for 24 hours. If you make the doubles up at ground level you have to wait a day before hauling them to the roof unless you’re very careful. Join male ends together via removable rubber couplings (no cement) or 1.5” glue-on pvc couplings. The pipe length between female ends can be varied to space the tubing around obstructions or to line the headers up with rows of tiles or to match the fin tube position depending on the roof type and configuration you are trying to achieve. Refer to the appropriate manual addendum for the roof in question. Notice the strap can’t shift off the removable coupling and damage the fin tubing because the gear clamps contain it. If using glue on couplings you can contain the straps using gear clamps and ss strap brackets as shown above.
You can see that when alternating the headers the coupling will sit right against the roof surface. In the case of a wearable roof surface like regular shingles we have to add a metal plate so the movement of the headers with temperature doesn’t wear thru the shingle at that point. Use wear plates to protect the roof. Normally we’ll just run an entire continuous length of galvanized roof flashing. Wear plates are not necessary on tile roofs but on tile roofs think about the movement of the headers as they change length with temperature. You want to be sure the fin tubes are not contacting the roof near the header manifolds because the movement back and forth will wear thru the fin tubes over time and cause a leak.

Staggered (shown above) means all the headers face the same direction and end up all glued. 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 unistrut. Always keep in mind headers and pvc pipe needs 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.
4.3 SIDEWAYS vs CONVENTIONAL

4.3.1 CONVENTIONAL

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

![Slope exaggerated](image)

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. See the animation under PLUMBING at [www.h2otsun.com/PG5ht.html](http://www.h2otsun.com/PG5ht.html) A corresponding slope on the bottom headers ensures the bottom headers drain.

Note that with Powerstrips it is perfectly acceptable to secure the bottom headers and the top headers. 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.

You 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.

4.3.2 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.
12

4.4 COLLECTOR MOUNTINGS

Hot Sun manufactures our own line of standard solar mounting hardware. As a contractor buying from Hot Sun please know the terminology. Strap clamps secure the ends of straps. Straps are vinyl coated 304 stainless steel. Strap brackets secure the strap to the roof through a flashing of some kind. Hot Sun methodology is far superior to the old school strap and bolt in place but these components still come in handy given the myriad of methods available in our toolbox.

Glue strips are simply 2 tube wide pieces of our fin tube material. These can be placed in advance under the fin tubes. Loctite PL Premium construction mastic can be used to glue the glue strip to each fin tube setting the final position of each fin tube relative to its neighbor. Glue strips are used on flat roof ballasted systems. On shingle roof sideways systems we now use our vinyl coated ss strap as the glue strip placed...
every 2 feet- see manual addenda. Our vinyl coated ss strap accepts adhesives. You can tack the fin tubes to it using the special CA adhesive and you can final glue it all together using the construction mastic.

Always use stainless steel screws on roof penetrations. Seal any roof penetrations with black polyurethane roof and flashing sealant as shown above.
Hot Sun makes the above roof connection hardware. These aluminum flashings fully and properly seal our aluminum flat bar mounts. 2” csk head #10 Stainless steel screws are used to seal the flat bar to the roof positively. With the multiple screw concept we do not need to hit the rafter. The idea is to grab the sheathing anywhere near the rafter. The aluminum flashing goes over and Unistrut galvanized structural steel can then be attached elevated the ideal ½” above roof level. Our flashings can accommodate double rows of Unistrut or single rows.

Hose clamp sliders secure manifolds directly to Unistrut allowing full movement as manifolds expand and contract with temperature….6 inches over a 30’ run! On a staggered arrangement take advantage of the pipe between headers and just clamp a slip collar right to the Unistrut. Do not overtighten. Make sure the assembly can move with temperature change. See manual addendum.

4.4.1 ADHESIVE MOUNTING - LOCTITE POWERGRAB (PG) OR LOCTITE PREMIUM 3x (PL) OR BOTH!

Loctite Powergrab (PG) is tackier. Its not as runny in warm conditions. PL is recommended on its own on flat installations where the runniness isn’t an issue and in situations where we are meeting structural engineering approvals for permits or hurricane ratings. Use the special CA adhesive to tack in place and finish with PL. On tile roofs the method is to alternate beads of PG and PL using 2 caulking guns. PG tacks in place so things stay put and PL provides the long term structural bond. PL Premium 3x is made by Loctite or Lepages. It sticks to the fin tubes and the vinyl coated strap and it sticks to tile.

4.5 ANGLED HEADERS

Headers can be angled to match the roof space.
Normally angled headers are used on left side headers, right side headers, bottom headers, but seldom on top headers. The fin tubes are separated into individual tubes and glued on one at a time. If using a glue strip, place one parallel to the angled header about one foot from the header. 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. More on that in the manual addendum. These photos show male end glued to pvc coupling glued to pvc pipe glued to female end and so on. Many variations are possible.

4.6 GOING AROUND CORNERS

You can "strip" the tubing so the web of 6 tubes is 6 individual tubes. This can help allow it to twist around a corner. 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.

For a better esthetic separate the 6 tubes wide strips into 3 tube wide strips before installing the system. Now you’re only dealing with a 3 tube wide strip. When you separate that out into individual tubes where you go around corners you can make a cleaner looking bend. 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.

5.0 PLUMBING

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.

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 but with 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 as well. 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. We like to use 1.5” because it can deliver enough flow in most cases without causing pressure and it’s so much neater and easier to work with. 2” on the other hand is less restrictive and can allow you to send all the flow without having to adjust BV1 or the motorized valve cam settings.

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. Install 1-1/2” PVC end caps on the remaining corner(s)

This is the vacuum breaker. Its just a ½ pound spring check valve. Mount it horizontally so it doesn’t trap water. It lets air in when the pressure goes below zero (well… ½ psi) to prevent plumbing 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.
All piping is schedule 40. That's the thickness. On residential installations the plumbing runs are either 1.5” or 2” PVC pipe. 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. Remember piping can expand and contract over a range of 6” over a 30 foot length. Don’t secure a pipe to a wall and then elbow onto the roof and run 30 feet straight to an elbow into a solar panel. Something has to give when that pipe expands. Every situation is different.

6.0 PRESSURE FLOW AND POWER CONSIDERATIONS

It’s important to understand that unglazed solar panels such as Powerstrips are made of thermo-plastics, plastics that can withstand high temperature, but plastics cannot withstand high pressures like metals can when combined with the high temperatures. Stagnating in Hot Sun and no wind, Powerstrips will get very hot. In making sure your solar system is compatible with your pool mechanical system we are making sure the system will operate stress free. This means minimizing the pressure on the collectors. Any non-metal solar collector will fail prematurely if installed under pressure regardless of the pressure capability the manufacturer claims. The fact is there is a lot of plumbing on the roof and a lot of water flowing and installing a solar system under pressure is asking for trouble in the long term.
7.0 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.

The sizing charts for cities around the US found under sizing on www.h2otsun.com are a good reference point when evaluating solar performance. If your system isn’t doing what our performance charts indicate then we want to know about it and we’ll figure out what’s wrong with your system or our predictions.

Remember, you don’t need a bigger pump. Keep the pump spec. under control and solar will not have to operate under pressure. Pressure is stress and why have stress if you don’t need it? Know how to tell your solar system is not under pressure and remember forever that it does matter if your filter or pump are ever changed or “upgraded”.

SERVICE: You can splice the tubing with ¼” pvc drip irrigation – see repair manual. Beware of polypropylene drip irrigation tubing. Make sure its pvc aka vinyl. You can always test it by seeing if it glues to itself with the CA adhesive. PVC cement bonds to the collector material as well as the headers. So does Krazy Glue or superglue. Use the gel versions of these products not the extra runny regular versions. Best is Gorilla brand superglue- see repair manual (under manuals at www.h2otsun.com). 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 to get pvc cement to flow into the joint.

Auto Controls: If its not coming on or off automatically as it should 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.  There is a small toggle switch on the motorized valve. Make sure the pool service guy didn’t switch that to the center position so the valve won’t turn or to the opposite position so the valve turns the opposite way it should. Parts for these control systems are universal and available worldwide. The motorized valves are pool industry standard parts.