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INSTALLATION MANUAL FOR POWERPRO SOLAR POOL HEATERS



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Warning: Hot Sun Industries Inc assumes no liability for injuries sustained attempting to install this yourself. Know how to work safely on a roof and with ladders or do not attempt this work.

Section 1: Installation of solar panels:

Step 1:

Plan the location of the collectors on the roof or mounting surface. This system must be sloped such that the top header pipes are at least 12" in elevation above the bottom headers. This ensures the system can drain for winterizing.

Each collector occupies 49" in width so, for example, a single bank of 10 panels will occupy 490" or 40'10". Add 8"-12" inches at each end for piping. Add 4" above the top headers for the mounting connection to the roof that "hangs" each collector See Fig 1.



Figure 1: Mounting top header

Tilting the bank of panels.

Step 2:

Note you want to tilt the entire bank of solar collectors so the bottom headers will drain and also so that air will rise up and out the return pipe naturally. See diagram start of next page. Slope the collectors $\frac{1}{4}$ " per collector so if there are 5 panels in a bank the headers will drop 1.25" from one end of the bank to the other. Snap a chalk line at this angle about 1" above where the top headers of the solar panels will be. Use this as your guide. Then make 2 more chalk lines for the locations of the straps across the collector bank. Measure down from the top chalk line according to Table 2

Step 3:

"Hang" the coupling between the first two collectors as shown in Fig 2. The roof connection on a shingle roof is done using a washer to spread the load out and make a seal over a larger area. This connection takes the weight of an entire collector. Use sealant then a big washer then sealant then a "strap bracket" then a #10 screw and crank it in tight. Use some of the supplied strapping, a strap clamp, and the extra hose clamp around the rubber coupling to make up this top connection. Don't do this at the bottom, just the top. **Figure 2...**



Step 4:

Complete the entire bank of collectors hanging every rubber coupling as above following the line you chalked 1" above the top header.

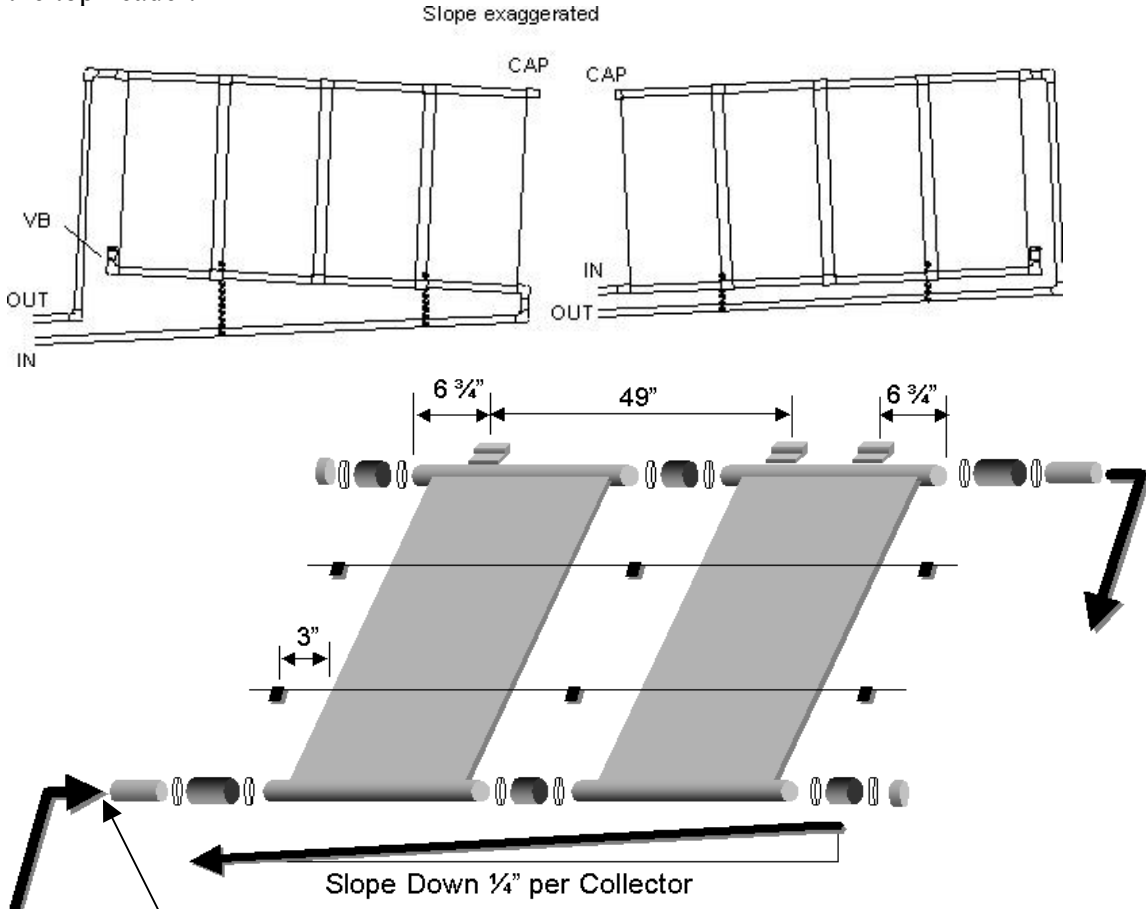


Figure 2 locate vacuum breaker here not as shown above because you don't have the right fittings

Collector Model	Upper Strap	Lower Strap
4x8	3' 9"	7' 3"
4x10	4' 9"	9' 3"
4x12	5' 9"	11' 3"

Table 2: Distance from Outside of Top Header Pipe to Strap Brackets

The brackets that hold the straps across the collectors (the strap brackets) will be installed after the collectors are in place.

Step 5: Install the outer strap brackets at least 3” from the edge of the collector as shown in Figure 3. Between collectors don't center the screw, center the "upright" of the strap bracket. Use sealant and make sure the roof connection is strong.

Step 6 Slide the polypropylene hold down strap through all the strap brackets and when you get to the end of the bank slide the strap through a Strap Clamp part No. 8023, then through the strap bracket and loop the strap as shown in Figure 3.



Figure 3: Strap, strap clamp, and strap bracket at end of a bank of panels

Tighten the screw firmly but not enough to puncture the strap.

Step 7:

Install the 2 end caps as shown in figure 2 with hoses and gear clamps. Connect

collector headers to the supply and return pipes with rubber hoses, coupling clamps and pipe to collector adapters. Note the adapters are cpvc so use CPVC cement between the adapter and the PVC pipe fitting. Note the 3 way “Jandy” valve (if used) in the next section, “Plumbing” is also cpvc so its connections to pvc will use the same special cement. Floerverter valves are regular pvc, not cpvc. You may have a 3 way compool valve that is pvc. Check your invoice to see if your 3 way valve is Compool (pvc) or Jandy (cpvc)

Step 8:

The vacuum breaker (Figure 4) must be positioned so it sits vertically relative to the center of the earth not relative to the roof. Install the vacuum breaker on a tee or tee and elbow as shown in Figure 2 near where the water enters the solar panel bank. (If you have one bank of collectors above the other located it on the pipe going into the upper bank.) Located here, there tends to be more pressure on the vacuum breaker keeping it closed during operation and avoiding noisy air entering the system constantly. It will still open when solar shuts off and let air enter so the panels can drain, avoiding negative pressure (which could collapse them when combined with heat). The vacuum breaker breaks vacuum. Use teflon tape on the threaded connection.

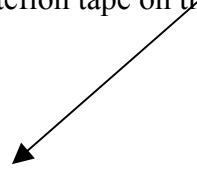




Figure 4: Vacuum breaker

Section 2: Plumbing

It is important that the whole system can fully drain by gravity to prevent freeze damage. Note the diagram on the second page showing how the panels must be tilted. This not only allows air to escape naturally as the system starts up but it also ensures full drainage of the lower header pipes. There will be piping running below the bottom header of the solar panels. This piping can be “hung” from the coupling between header pipes. Use the coupling clamp (the gear clamp) as shown and hang the pipe with the plumber’s strap (part of the plumbing kit) and a small nut and bolt.

Don't bolt down the piping. It needs to be able to move with temperature. Under any plumbing fittings on shingle roofs use wear plates (under the elbows). These can be small sheets of galvanized steel or aluminum available at the hardware store or pieces of extra shingle material. Also use these under the couplings between solar panels on shingle roofs because the couplings will otherwise dig into the roof over time as the headers change length with temperature. Use sealant only to secure the plates in place.

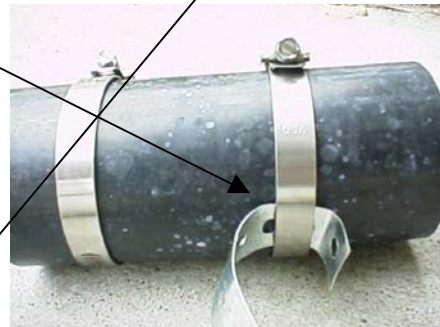
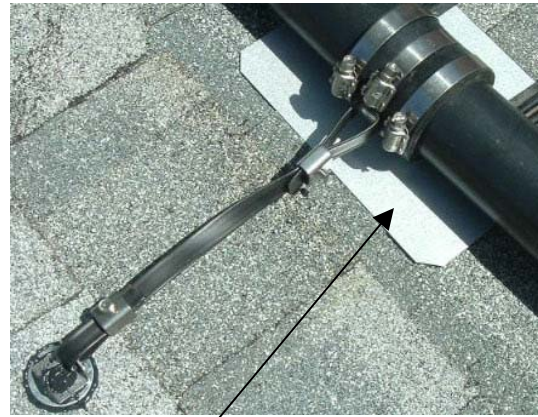
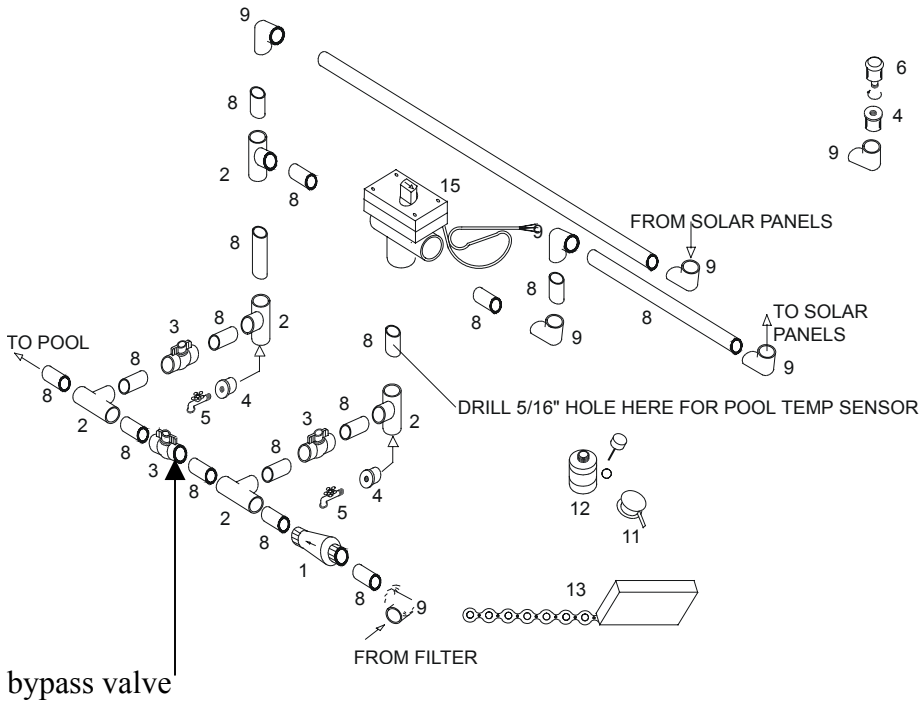


Figure 5: Plumbing



If a pool vacuum pump is installed after the filter, solar should go downstream of this so that the air from solar when starting up doesn't get exposed to the vacuum pump causing it to run dry. There are many other variations on the standard plumbing configuration shown in Figure 5. In the configuration shown, the motorized or manual 3 way valve is not a "positive sealing" valve. It doesn't divert all the flow. This ensures the collectors can drain down when solar is off. If the pressure in your pool system is too high or the solar panels are below pool level then the panels will not drain down and we use a positive sealing valve and the plumbing scheme may change. Your pump probably puts out more flow than we want to operate solar. For good solar efficiency we do want a high flow rate but not so high that the flow is restricted by the solar panels and piping. Up to about 10 gpm/panel is allowable and we only need 2gpm/panel for efficient operation. The bypass valve adjustment gives us the flexibility we need to deliver the right flow to the solar panels. The other two- 2way valves (the easy way to remember 2 way vs 3 way valves is the number of ports) are isolation valves closed only to winterize the system. Otherwise leave them fully open. Two way ball valves are fully open when the handle lines up with the pipes they are glued into. They are fully closed when the handle looks like it is blocking flow.

The drain points are at the lowest points. Imagine the pump shutting off. All the water must be able to drain down to the 2 drain points. Add extra drain points if needed. Fig 5

shows "hose bibs" making the draining process simpler. Remember that ball valves trap water inside them if closed full of water. Empty the system first by shutting off the pump and letting all the water out before closing the isolation valves for winter.

Solar will normally tie in after the filter but before the back up gas heater if one is used. Often we will specify that solar should be after the gas heater in order to allow solar to operate under a lower pressure so that solar drains down properly when off as described above. Pay attention to the custom instructions with your system.

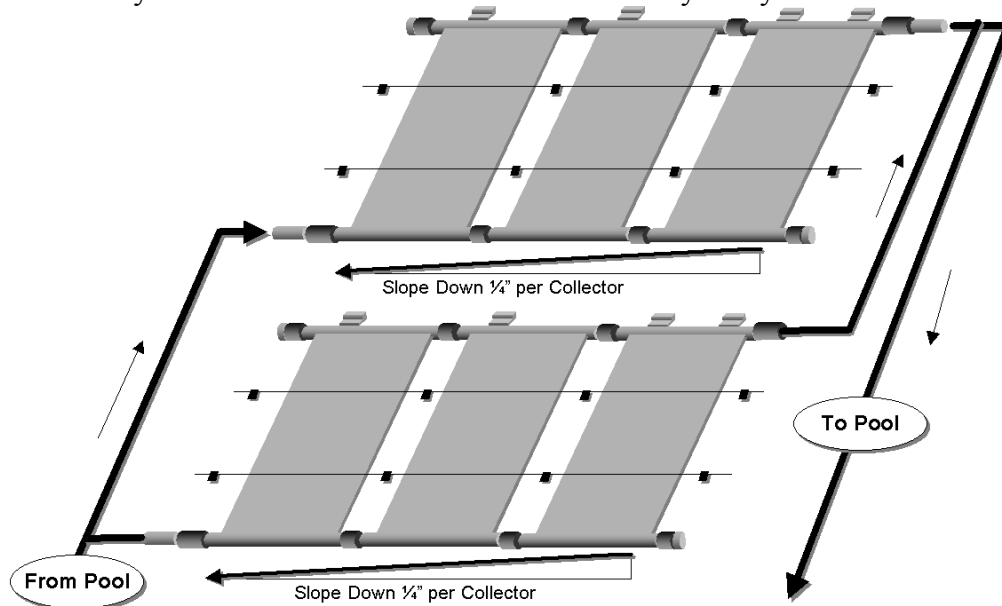


Figure 6

Note strap positions are not correctly shown on these diagrams and the top mounting details are a little different than indicated.

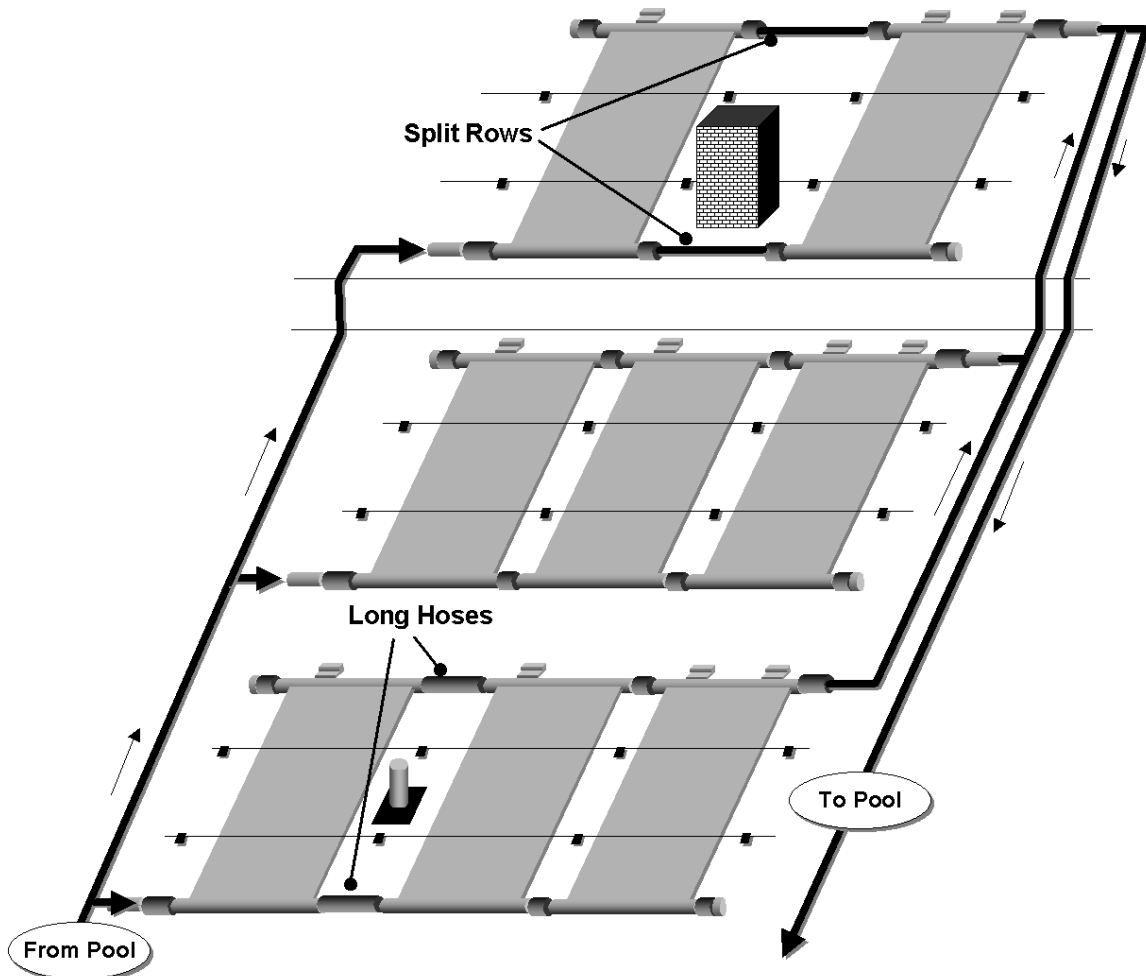


Figure 7: Multi-Row Multi-Level System

Figure 6 and 7 show multiple bank situations plumbed in parallel. Its important to note that every molecule of water must reach the highest point in the system before being allowed to fall back to the pool. Plumbing shortcuts are tempting can make a bank of panels non-functional. You can always verify good collector performance by feeling the solar panels when operating in Hot Sun. If you feel a variation in temperature or hot spots then something is wrong. Solar panels should feel evenly pool temperature.

Section 3: Automatic controls

The motorized valve has 3 wires. The “common” (C) wire is black. The other two wires are green and red or white and red. These are called NC and NO. If NC and NO are reversed the valve will turn the opposite way that it is supposed to so if this happens simply switch those 2 wires on the control. Flo-verter motorized valves have handles that can be lifted off. The valve stem beneath has an arrow on it showing which way the valve is turned. The pool temp sensor is a drill in type. You drill a hole the correct size in the piping anywhere before the solar tie in so you are sensing pool temperature. The sensor on the roof senses the temperature the solar panels would be at if they were empty. This sensor must be located where it sees the same sun as the solar panels. That doesn't necessarily have to be on the roof next to the collectors! If this temperature is higher than the pool temperature (by more than 6 degrees) then the control knows there is solar heat to be gained. The control turns the 3 way motorized valve to send water thru solar or not depending on the 2 sensor temperatures and the maximum pool temperature you've dialed in to the control. The valve is either solar on or solar off.

Sensor wires should be 22 gauge or larger (smaller gauge number) and should be braided copper wire, not solid. Soldering the wires is best. I use a propane torch and resin core electrical solder. Tape it up with electrical tape making sure you don't create a short. The 2 sensors are negative temperature thermistors which means as their temperature decreases their resistance increases. If the control malfunctions the most likely cause is a bad connection. A bad connection to a sensor on the roof would mean the control would think the temperature on the roof was very **low** (open circuit is **high** resistance). This failure mode would show up as the control always being solar off. Similarly if there was a break on a wire to the pool temp sensor solar would be on always. Simple checks can be done where you short out the wires to a sensor and see what happens. Then open circuit wires to sensors (disconnect them) and see what happens. Common sense allows you to fully troubleshoot your system. Aside from wires the next most likely problem is roof sensor failure, then pool temp sensor failure, then control failure. Valves can be tested easily by switching the control to test or to solar off (bypass).



This is the Flo-verter valve. It is regular pvc and purposely not positive sealing. It is fully field serviceable without removing it. Note the handle on the top lifts off and a small arrow verifies which way the valve is turned. Water always goes in the bottom and comes out the left (marked to solar) or the right for solar off.

Section 4: Racks



If 12' long panels are to be used we normally use 12' long 2x4's running up and down the slope with a header and footer (like a "wall") so the total dimension becomes 12'3". Use 2' centers. Support this "wall" with posts every 3 joists (6 feet). Notice in this rack the "wall" cantilevers out a foot from the row of posts. Don't use nails. Use a pilot drill and wood screws. Once complete additional lumber can be added to truss the rack giving it better stability.



Many variations are possible. Check local building codes. The important thing is that the structure be able to withstand snow and wind load. The solar panels only weigh one pound per square foot full of water.

"Sheet" the surface with 1x4's or 1x6's or whatever you like. 50% of the surface is adequate but more insulates the back of the collector more .



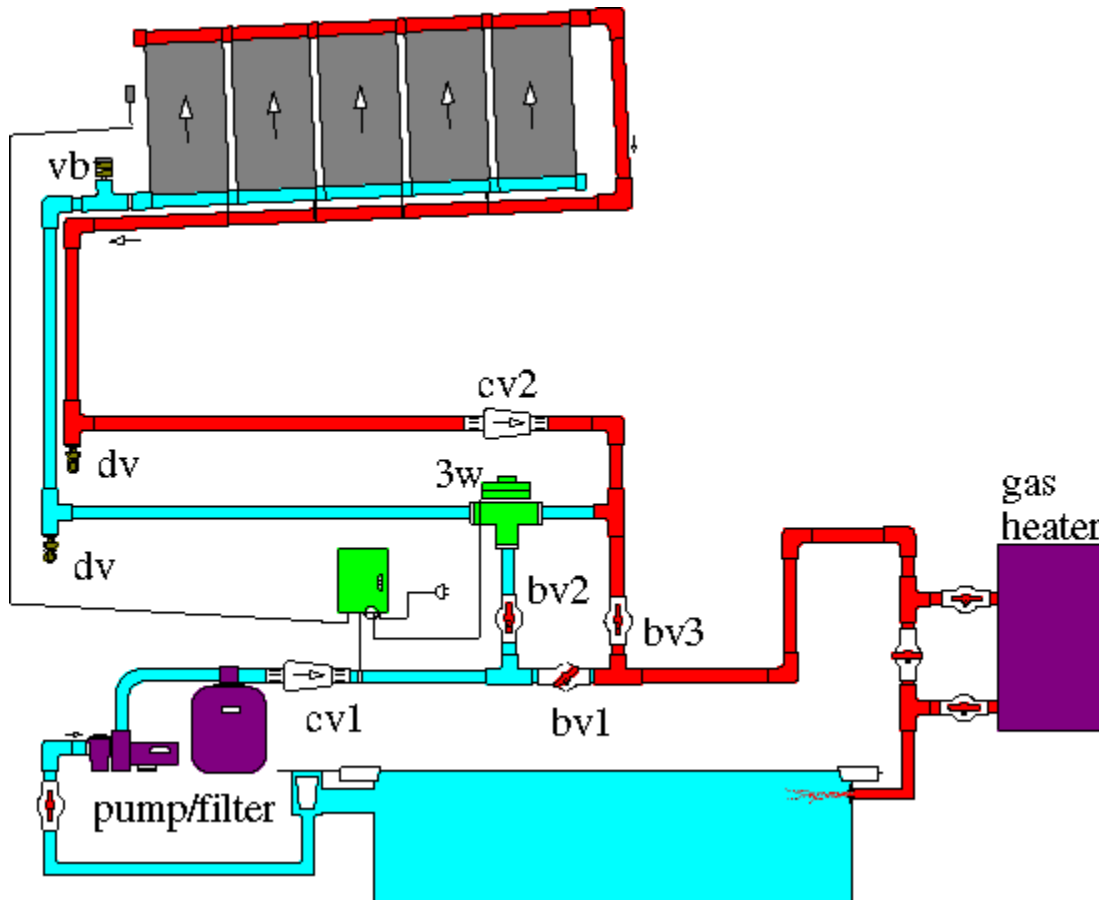
Note in this design , 2 horizontal beams are used to support the "wall". This makes it easier to maintain a level and is almost certainly a code requirement.

For our posts, local codes may require steel "post anchors" set into large concrete footings or pier blocks, (not like what you see here).



The angle the rack is tilted to is not as critical as you might think. Look at how directly the surface sees the sun in the earliest month you expect to be able to use the pool. Face the rack true south but tilt it for aesthetics and construction convenience. Make the rack level and tilt the panels relative to the rack as shown on page 1.

Section 5: System Start Up and Operation



Check your specific instructions for your situation with your dealer. This is the most common scheme but it depends on a low pressure tie in. Start with the bypass valve (bv1) fully open, drains (dv) closed and isolation ball valves (bv2 and bv3) open. The first check we need to do is to make sure the height of the water column with solar off isn't greater than the height of the solar panels. In other words check that there is no pressure in the solar panels. We want this situation so solar drains down to when off and so that the solar panels are not pressurized when solar is off. Install a pressure gauge somewhere convenient to do this test. You can swap the vacuum breaker with the gauge for the purpose of this test or you can install the gauge in the drain location on the feed pipe or on a separate tee. We want to ensure the pressure in the solar panels is zero or less. If the pressure gauge location is 10 feet in elevation below the solar panel's elevation then we want to see less than $10' \times 0.433 \text{ psi/ft} = 4.3 \text{ psi}$ on the gauge (zero at the collector height). In the vacuum breaker location we want to see zero psi with solar off. If the pressure is higher than this then try to correct it by reducing the restriction to flow downstream. Enlarge or remove the inlet orifices to the pool, bypass flow around a gas heater downstream, or contact dealer for assistance.

Once there is no pressure in the solar panels with solar off we want to adjust the bypass (bv1) so we don't send too much flow to solar. Start with the 3 way diverter valve (3w) turned towards solar. The bypass valve (bv1) is still fully open so there's no flow to solar yet. Begin to close the bypass valve (bv1) slowly until the air flushes out of the solar heater into the pool. Don't close the bypass valve any further. The pressure on the solar panels should still be zero or very close to it. If not, contact the dealer and work through the situation with him. There is no reason solar panels need to be under pressure. People always make the mistake of thinking you need pressure to drive enough flow through the system or you need pressure for heat transfer. That is not true when the system is as free flowing as this. An immeasurable pressure difference drives adequate flow thru solar. Don't skip step one. You have to have zero pressure with solar off before you can get low pressure and proper operation of this system with solar on.

With the bypass valve (bv1) adjusted correctly it shouldn't ever have to be adjusted again. It's possible that as the filter gets dirty and the flow drops, the bypass may need to be closed further to start the system up.

Air flushing into the pool every sunny morning when the pool isn't up to temperature is your indicator that solar has started up properly and also that solar did drain down when turned off. If you change the pool pump or alter the pool mechanical system in some way the pressure in the solar panels may change and a good clue is that you no longer get the flush of air into the pool upon start up. Note that the situation I am referring to is the pump being on 24 hours a day and the solar diverter valve turning to drive solar or not as appropriate. If the pump is shut off then the pressure will always go to zero and the solar panels will always drain down and there will always be a flush of air even if the pressure is too high so if you use the pump to semi-automate the system (leaving solar on manually most of the time) remember to check for air from time to time by opening and closing the solar valve without shutting off the pump. With pump on, just turn the diverter valve to turn solar on, then turn it off, and wait, then turn it on again and verify that a big flush of air does enter the pool.

Another important test to understand is that the collectors should not be warm when operating. They will feel evenly pool temp even in Hot Sun. Use this check to verify the solar panels are plumbed correctly and operating at top efficiency. If you can noticeably feel the temperature increase from the bottom of the panels to the top then the flow rate through the solar panels needs to be increased (close the bypass valve a little more). Cold solar panels are efficient solar panels. Don't confuse temperature with energy. You want flow AND temperature rise, not just temperature rise. The collectors operate more efficiently when they are colder so higher flow and lower temp. rise is better than a trickle of hot water into the pool.

Winterizing:

- 1) Shut the pump off and wait for the water level to drop.
- 2) Open the drains and get the rest of the water out.
- 3) Open the bypass valve fully and close the two isolation valves

4) Make sure there is no water trapped anywhere. Disconnect a coupling between header pipes on the roof to be sure.

Start up in spring is the reverse.

OTHER ROOF TYPES:

Consult separate documents for details on how to adapt this system to tile roofs, wood shake roofs, etc. This system is not appropriate for low pitch or flat roofs in climates where it may freeze. You cannot blow the water out with compressed air. Its hundreds of tubes in parallel. We have flexible products available that can stay full of water and freeze in winter.