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Solar Thermal Installation Manual

For the SPP-30A, SPP-30, SPP-25, & FP 1.20 Collector Systems

02/01/2012 Manual – Rev A

1. Preface

Thank you for purchasing a Solar Panels Plus thermal collector. Solar Panels Plus is a American company based out of Virginia that is one of the leading manufactures of evacuated tube products. Our solar thermal equipment is sold and installed by leading solar, heating, plumbing, and other top quality contractors across North America.

This solar thermal collector has been tested and certified to the Solar Rating & Certification Corporation (SRCC) Standard OG-100 certification, which is required by most federal and state government entities as well as various local and utility entities in order to qualify for various financial benefits, such as tax credits, rebates, and loans.

Note: Certification by the SRCC does not imply endorsement or warranty by the SRCC.

The installation of this collector, the components, and the system in it's entirety is intended to be performed by properly licensed and experienced professional contractors in conformance to applicable federal, state, and local regulations, codes, ordinances, and standards governing the installation of solar water heating systems.

This system is designed to function using a heat transfer solution fluid (HTF) containing non-toxic, food grade, propylene glycol and de-ionized water. Unauthorized fluid substitutions can result in a threat to health, welfare, and safety, as well as result in pipe freezing, equipment damage, or otherwise hamper the performance of the system.

When this system is properly installed and maintained, it will be protected against freeze damage to temperatures well below 0°F. The system's freeze protection is contingent upon the mixture of HTF (glycol to water ratio).

Solar water heating systems are climate and sit specific appliances. System performance varies as a function of household hot water use, including daily showers and baths, laundry and kitchen uses, local ground water temperatures and ambient air temperatures, cloud cover, the site's roof pitch & orientation, seasonal intensity of solar radiation, and other factors. These variables determine how much energy your system will produce, and therefore, how much money your system will save. When sized properly, your Solar Panels Plus solar hot water system can product between 50% and 80% of your hot water demand on an annual basis.

2. Operating Principle

This system operates on the simple principle of collecting heat from the sun and transferring it into a storage tank for use when needed.

When the sun is shining, heat energy is absorbed by the solar tubes and transferred into the heat pipes in the center of the tubes. The tubes retain a high percentage of this heat because of the vacuum between the inner and out glass walls, which prevents collected heat from escaping. The heat pipes contain water in an evacuated state, lowering the boiling point of the water to a very low temperature. This allows the heat being collected from the sun to boil the water, and push it to the top of the heat pipes.

The heat pipes sit inside the manifold of the solar collector, where the HTR passes through. This fluid is pumped using a circulating pump that is operated by the systems controller, which is activated when the controller detects heat inside the collector. This fluid is then heated as it passes through the manifold, and is circulated through a heat exchanger inside the tank. As this hot fluid passes through the heat exchanger inside the storage tank, the water in the tank is heated for use throughout the day whenever it is needed.

3. Installation Options

Many installations of this system will produce 100% of hot water requirements using solar energy on sunny mid-year days. However, on cloudy days and fall/winter days, a backup heat source is required.

Installation Option #1: Single Tank Solar System

This installation option uses a solar storage tank that has a built in electrical heating element built in. This option is some times preferred when floor space is too small to accommodate having two tanks in place.

Single tank systems require electrical service to power the backup element. There are a variety of tanks that have a backup electrical element, however normally the electrical element is located midway or near the top of the storage tank.

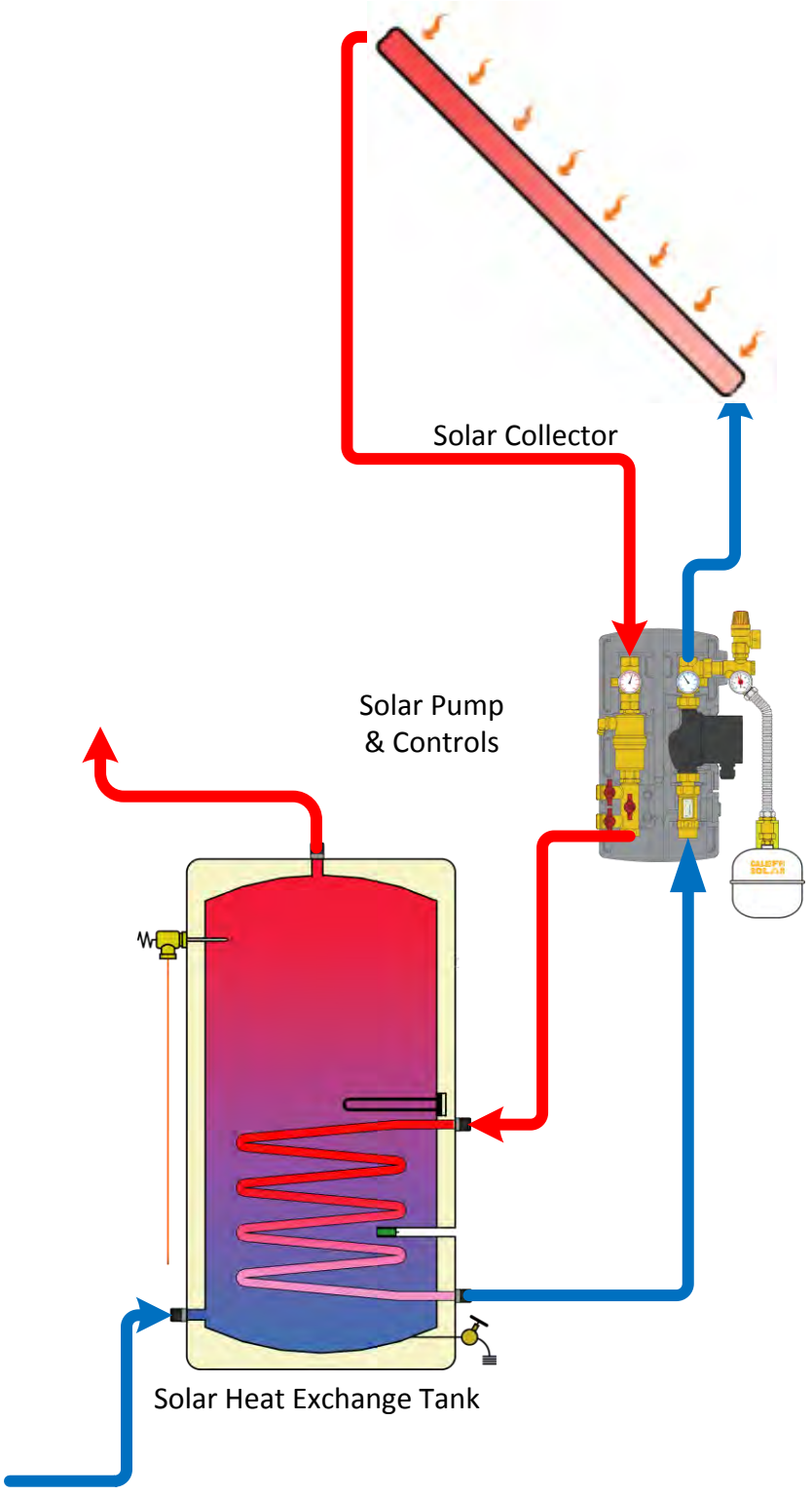
Usually, the adjustable thermostat is pre-set for 120F. When the tank temperature falls below 120F, the thermostat activates the heating element to bring the water temperature back up to 120F.

To maximize solar gain from the collectors, you may wish to install a programmable control timer for the tank's thermostat. The control disables and enables electrical power to the back-up element at various times of the day.

A typical use is to disable the element during times when no hot water consumption is planned, thus allowing more time for the tank to be heated by solar energy instead of electrical energy.

A common example is disabling the element in the morning after inhabitants have left for work or school, then enabling the element an hour or so before people are expected to return.

This allows the solar system to work throughout the day to heat up the solar tank without the assistance of electrical energy, while providing a backup if it is needed during times of day when the demand may be heavy.

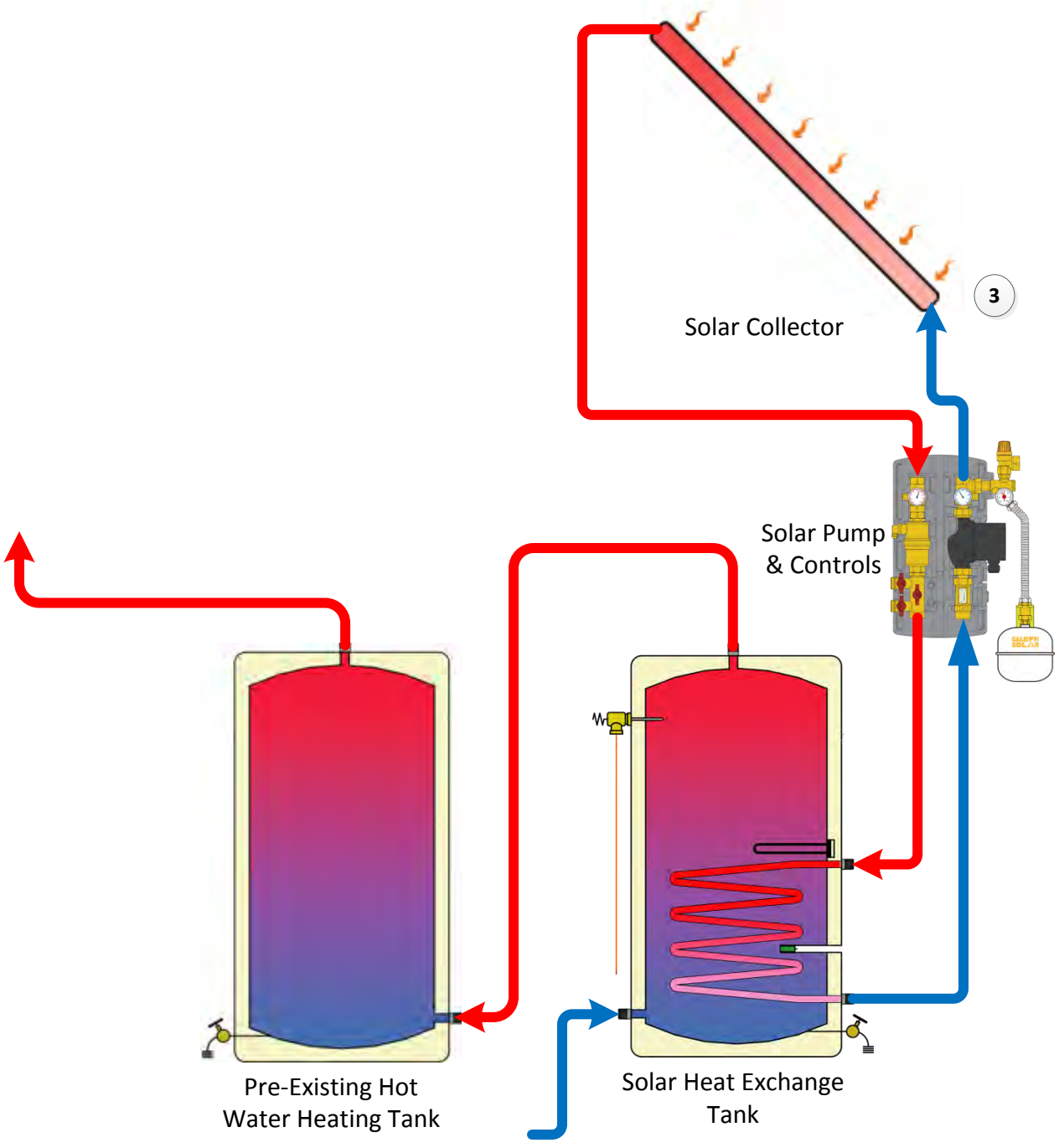


Installation Option #2: Two Tank Solar System

This is a more commonly used option and uses a conventional direct fired hot water heater as a second tank. The conventional tank is usually already in place prior to the start of the installation. Normally, the cold water from the ground is fed into the conventional tank, where it is heated with electricity or gas, which then supplies hot water to the home or business.

This is commonly seen in installations where an existing hot water tank is already installed. Unlike the first option, a means to disable back-up heat is not required to optimize solar harvest as the entire solar storage tank volume is dedicated to solar heat collection.

It is high suggested that bypass valves are installed in order to isolate the solar storage tank. This will allow hot water production if the solar storage tank ever requires servicing and must be taken offline temporarily.



4. How It Works

1. Evacuated Tube Collectors: This part of the system harvests the energy (heat) from the sun. The system can contain a single collector, or multiple collectors. They are installed outside, facing skyward in a southerly direction. These collectors can be mounted on the ground, but generally the roof or another raised surface is more appropriate. These collectors should be positioned to maximize the solar energy collected throughout the year. This will generally mean installing the collectors facing south with their tilt being at latitude or as close as possible.

Different mounting options are also available for the evacuated tube collectors. All collectors are shipped with a flush mount frame, however a high angle frame is also available for ground mounting, flat roof mounting, or to give a high angle that the roof might allow.

2. Solar Storage Tank: The storage tank is installed indoors, and is the device that the heat collected from the evacuated tube collectors is transferred into. The transfer of solar heat is accomplished by the heat transfer fluid (HTF) circulating through a heat exchanger that is part of the solar storage tank. Some tanks will have a built in backup heat source, such as an electrical element. This is highly recommended for single tank installations. It is not usually required for two tank installations.

3. Pump/Pump Station: The pump / pumping station is what circulates the heat transfer fluid (HTF) in the system. Pumps can come in a variety of sizes, speeds, and options. It is suggested that if a large, commercial, or custom pump is used for your system, to review the operation and installation manual provided by the manufacture of the pump. If your pump was specified and supplied by Solar Panels Plus, your sales representative at Solar Panels Plus can provide you with the needed information.

The pump station is an assembly of a pump, fittings and safety devices that are critical to the operation of the solar system:

3.1 Pump: The integrated pump in the pump station circulates the HTF through the system and activates when the controller detects that fluid in the solar collectors is above a certain temperature. The pump in the pump station is usually rated at 115V, 60 hertz, and is wired directly to the controller. The pump has 3 speed adjustment settings to assist in setting the proper flow rate for the system.

3.2 Safety Relief Valve: Protects the system mechanicals from the effects of over pressurization. Opens up in the event rated pressure level is reached. A drain line is generally used to safely direct to the floor any purged HTF.

3.3 Filling/Drain Valve: Contains 3 ball valves and is used to fill or drain the system of HTF. The center valve is also used to adjust pump flow rate.

3.4 Pressure Gauge: Indicates system pressure. Contains a dial arm to show previous set pressure.

3.5 Flow Meter: Indicates the current flow rate of the HTF.

3.6 Air Trap and Vent: Collects air in the cylinder upon system start up.

3.7 Flow & Return Temperature Gauges: Round thermometers that indicate the temperature of the HTF going to the solar collectors and returning from the solar collectors. These two gauges allow for a simple diagnostic check of proper system operation. On a sunny day the hot return line is typically 8°F to 15°F warmer than the supply line.

3.8 Preformed Insulation: Insulates pump station assembly from heat loss and provides a mounting surface for controls.

3.9 Shut-off and Check Valve: Located directly behind the temperature gauges. Check valves prevent unwanted thermo-syphoning of HTF. The shut off valve isolates the pump station from the solar collectors to allow for servicing without having to drain the entire system. The valves can also be set to keep checks open to allow thermo-syphoning to occur.

4.0 Controller: The system controller is the “brains” of the system. It acts as a type of thermostat and monitors the temperature of the HTF in the solar collector, the associated loop, and the water in the solar storage tank.

The controller activates the pump as conditions require. There are a variety of controller models that can be used with a variety of features, such as variable pump speed control, extra electric relays, data logging, and more.

5. Heat Transfer Fluid (HTF): The Solar Panels Plus thermal system design is known as a “closed loop” or “forced circulation loop” because it uses a pump to circulate HTF in a closed system under a small amount of pressure. The HTF is a mixture of non-toxic, food grade corn or propylene glycol and de-ionized / distilled water. The HTF protects the collector and exposed piping from freezing and inhibits internal scaling deposits which can reduce performance.

The glycol and water ratio can be altered to achieve different degrees of temperature protection. Usually, the mixture is 1:1 (1 part glycol to 1 part water). At this ratio (also known as a 50% mixture) the system will be protected down to -20F.

6. SolarFlex (Pre-insulated Lineset): SolarFlex is a stainless steel high temperature, flexible piping with a preformed external insulation wrap. The SolarFlex has Union fittings to facilitate connection to the pump station and with the solar collectors.

7. Heat Dissipation: Heat dissipation units are available to protect the evacuated tube collectors from overheating during periods of low hot water usage. These are designed to mount near the collectors, and can be attached directly to a high angle frame. Normally used in conjunction with a thermostatic diverting valve or an electronic valve that is operated via the controller.

5. Installation – Safety & Guidelines

5.1 The installation of the solar thermal system in it's entirety shall conform to all federal, state, and local regulations, codes, ordinances, and standards governing solar water heating systems and installations, and the contractor shall adhere to sound building safety and trade practices. Special consideration must be given to building code requirements for the penetration of structural members and fire rated assemblies.

5.2 The installer shall have proper safety equipment when working with elevated surfaces, hot water, heating systems, electrical systems, or any other systems that could pose a danger to himself or anyone around him, and he shall take necessary precautions to ensure a safe work environment.

5.3 The homeowner, business owner, or other appropriate person(s) and the installer shall confirm the location of all components – roof mounted or otherwise – in advance of the installation.

5.4 The solar panels must be located in a structurally sound area of the roof that will be un-shaded for the majority of the day all year round. Adjacent trees, buildings, and any other obstacles should be checked for winter shading.

5.5 Before the installation begins, the installer shall inspect the condition of the roof and any other surfaces pertaining to the solar hot water system, and notify the owner or other appropriate person(s) of any existing damage or any repairs that may be needed.

6. Installation – Specific Requirements

6.1 **Collector Orientation:** The performance of solar hot water heating systems in North America is optimal when the collectors are facing True South. However, performance suffers very little when the solar collectors are oriented within 30 degrees East or West of True South.

6.2 **Collector Tilt:** Optimal efficiency is achieved with solar collectors when the tilt is at an angle that equals your latitude. However, performance suffers very little when the solar collectors are tilted within 15 degrees (+/-) of latitude.

6.3 **Collector Shading:** The solar collectors should be un-shaded by any permanent fixture or obstacle between 9:00am and 3:00pm on any day of the year.

6.4 **Collector Mounting:** The solar collectors should be mounted as close to the solar storage tank as possible in order to minimize heat loss in piping runs.

6.5 **Roofing Considerations:** The solar collectors shall be mounted on the roof in accordance with the following principles:

a) The most important structural consideration is to securely anchor the solar panels foot mounting hardware to the structural members of the roof with stainless steel fasteners.

b) Always note the material of the roof you will be mounting to. When you are installing on a metal roof, it is important to select mounting hardware and fasteners that will avoid galvanic corrosion resulting from the direct contact of incompatible metals. Special hardware and rubber pads are available for installation on a metal roof.

c) Preserving the integrity of the roof membrane is important. Ensure that all roof penetrations required to plumb and mount the solar panels are properly flashed and sealed in accordance with standard roofing practices.

d) If the region is subject to hurricane conditions, additional steps may be required to secure the panels and mounting hardware to the structural members. In certain areas of the country, local building codes may require panel wind load testing or prescribe specific mounting procedures. Consult your local building department.

6.6 **Piping Insulation:** A high temperature, weather resistant piping insulation should be used on all exposed pipe that is used for the solar collector supply and return lines. A pre-insulated line-set called SolarFlex is often used to ensure piping runs have appropriate insulation and to minimize heat loss.

6.2 **Back-Up System Connections:** Interconnection of the back-up heating portion of the system to the solar portion of the system shall be made in a manner which will not result in excessive temperature or pressure in the back-up heating system or bypassing of safety devices of the back-up system

6.3 **Installing Solar Storage Tank, Expansion Tank, & Pump/Pumping Station:** When plumbing the solar storage tank and expansion tank, make sure all the components are accessible and easy to reach. Provide for clear access to the storage tank, pump / pumping station, expansion tank, mixing valve, controller and other key components. The controller should be located in close proximity to a 115 volt electrical receptacle.

The storage tank should not be placed directly on an un-insulated floor or concrete slab. The tank should be placed on a well insulated pad with a minimum R-value of 10. A 2" rigid polystyrene insulation pad is a good solution. For a two tank system, position the solar storage tank in close proximity to the back-up hot water heater or boiler to simplify plumbing.

If a component in the potable water side of the system may require future service or maintenance, make the connections with brass unions. Use only brass nipples and unions and copper and brass fittings in plumbing the solar storage tank. The use of galvanized fittings or nipples, di-electric unions, CPVC, PVC or other plastic pipe is not recommended.

Hard copper connections to the city cold water supply line and the home hot water feed lines are recommended. The gaskets in standard water heater flex hose connectors can become brittle and compressed over time and begin leaking on the water heater. If not detected in a timely manner even a small drip or leak may cause serious damage to the tank's electrical components or, in extreme cases, may cause the tank to leak from the outside in.

All interconnecting hot water piping and the final 5 feet of metallic cold water supply pipe leading to the system, or the length of piping which is accessible if less than 5 feet, shall be insulated with R-2.6 or greater insulation.

6.4 **Building Related Installation Requirements:**

Firestopping **-** The SWH system components shall be assembled such that fire stopping shall be possible at time of installation, if required by local codes and ordinances.

Space Use **-** Solar components should not reduce or increase humidity, temperature or thermal radiation beyond acceptable levels or interfere with required headroom or air circulation space.

Building Penetrations **-** Penetrations of the building through which piping or wiring is passed shall not reduce or impair the function of the enclosure. Penetrations through walls or other surfaces shall not allow intrusion by insects and/or vermin. Required roof penetrations shall be made in accordance with applicable codes and also by practices recommended by the National Roofing Contractors Association.

Water Damage **-** Collectors and support shall be installed in such a manner that water flowing off the collector surface will not damage the building or cause premature erosion of the roof.

Structural Supports **-** Neither wind loading (including uplift) nor the additional weight of filled solar panels shall exceed the live or dead load ratings of the building, roof, roof anchorage, foundation or soil. Solar panel supports shall not impose undue stresses on the solar panels. The design load shall be as specified by the codes in force at the installation site and shall include an additional load due to snow accumulation for applicable locations.

Penetration Of Structural Members **-** When penetrations are required in structural members to accompany passage of solar components, those modified structural members shall comply with local building codes.

Protection From Thermal Deterioration - Building materials adjacent to solar equipment shall not be exposed to elevated temperatures which could accelerate their deterioration. Many non-metal roofing materials will soften in the temperature range of 140-180ºF and begin to degrade above this temperature.

Penetrations Through Fire-Rated Assemblies - Penetrations through fire-rated assemblies etc. shall not reduce the building's fire resistance required by local codes, ordinances and applicable standards.

Emergency Egress and Access -The design and installation of systems shall not impair emergency movement of the building occupants.

7. Installation Directions

7.1 Overview

This section of the installation manual is a step by step instruction of a typical solar hot water system installation. Only the solar side of the installation is explained in this manual, since back-up equipment, existing tanks, etc. are application specific and vary from project to project. Though not representative of every installation, these instructions will greatly simply the task of installing a Solar Panels Plus hot water system.

7.2 Tools Required

- Foam pads for roof installs
- Propane torch (for installs requiring brazing) & striker
- Flux & wire brushes
- Pipe reamer
- Voltage meter
- Solder box
- Paint brush
- Garden Hose
- Caulking gun
- Glycol pump w/ 5gl bucket
- Ladder(s) for roof installs
- Fall protection gear
- Tape measure
- String or chalk line
- Drill & screw gun w/ bits
- Wrenches in various sizes
- Channel Lock pliers
- Hammer
- Reciprocating saw w/ blades
- Cutter for PVC & copper pipe
- Gloves

7.3 Parts Check and Uncrating

At the installation site, begin by opening the crate or pallet your solar collectors were shipped in. Remove the individual components, open each box, and familiarize yourself with the contents. It is advised to label the various boxes and organize them to make it easy to find specific components during the installation.

Locate and open the box containing the evacuated tubes with the heat pipes & fins installed. Check to ensure that all of the evacuated tubes are intact, and the bottom of each tube is silver. (Note: A check of the evacuated tubes should also be performed upon receiving your shipment initially, before signing the bill of lading).

If a tube has a white or clear bottom, the tube has been damaged and has lost it's vacuum, and must subsequently be replaced.

To do this, simply remove the heat pipe and fins from the damaged tube and insert them into the replacement tube. For every SPP-30A / SPP-30, two replacement tubes are included. For the SPP-25, one replacement tube is included. If more are needed, they are available for purchase from Solar Panels Plus – contact the Sales Department for details.

It is advisable to always handle the evacuated tubes wearing gloves to avoid leaving finger prints on the tubes. The oil from your hands will attract dirt, and can leave noticeable marks on the glass.

Note: Do not fully remove nor expose the tubes to sunlight until you are ready to install them (after the loop has been completed, charged, and pressure tested). When the tube is exposed to sunlight, the tip of the heat pipe will become extremely hot, and can cause serious skin burns. The outer glass surface will not become hot.

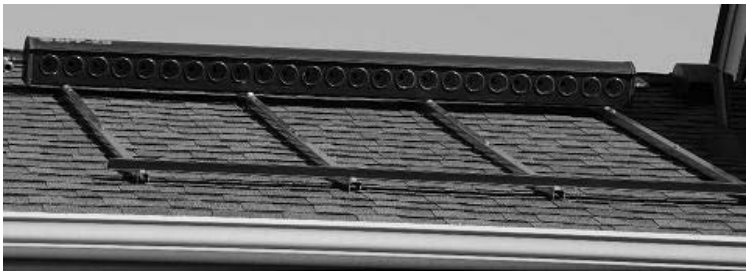
IMPORTANT: Never touch the inside of an evacuated tube, nor the heat pipe tip after exposure to sunlight. This can result is serious burns.

Unpack the standard frame – this is packaged in the box with the manifold. All SPP-series collectors come with a standard flush mount frame.

If a frame kit – such as an angled frame – is being used, these components will be packed separately from the manifold. In this instance, both the flush mount frame parts in the manifold box and the parts for the angled kit will be needed.

Depending on the material of the roof the collector is being mounted to, rubber feet may be included. These are different from rubber pads, which are included (x9) in every flush mount frame kit, which is packaged in the manifold box.

7.4 Locating the Collectors on Roof & Marking Roof Penetrations



Step 1: Begin by outlining with chalk or a marking pen where the collectors are to be mounted on the roof.

The SPP-30A/SPP-30 dimensions are approximately 97" x 79", and the SPP-25 dimensions are approximately 81" x 79.

It is helpful to first unpack the flush mount frame from the manifold box of the collector, and lay the collector's front legs, tube rack, and manifold out on the roof to determine exact position before roof penetrations are made.

Note: In determining the positioning of the collector, take care to insure that your piping can be routed through the roof without obstructions from below. In some installations, you may wish to install the piping down the side of the building instead of through the roof.

Collectors should ideally be mounted at least 12 inches down from the roof peak. This will keep them away from potential up-lifting wind conditions, and keep the manifold away from the roof cap and any ridge vents.

Step 2: Once the collector has been positions, use a chalk line to snap a horizontal line where the bottom of the collectors will go, along the tube rack. Along this line, you will next mark where the rafters underneath intersect and where you will sink your fasteners to secure the frame to the roof.

7.5 Locating Rafters & Marking Fastener Locations

Step 1: Mark off along chalk line where the rafters intersect. Usually, rafters are spaced 16" or 12" apart, on center.

This can be done in a few different ways. If you have access to the attic below, you may choose to measure off from a plumbing vent, chimney, or other roof penetration. If there isn't an existing roof penetration, use a small 3/16" by 12" long drill bit to make a small pilot hole just next to the rafter. This hole can then be used to measure off where the rafters are located. (**Note:** After being used, the pilot hole should be sealed with silicone caulk or some other type of roofing patch, depending on the type of roofing material.)

Step 2: For each collector, choose the intersections that match up with where your collectors will be mounted. The collector frame is designed to match up to rafters that are either 16" or 24" on center.

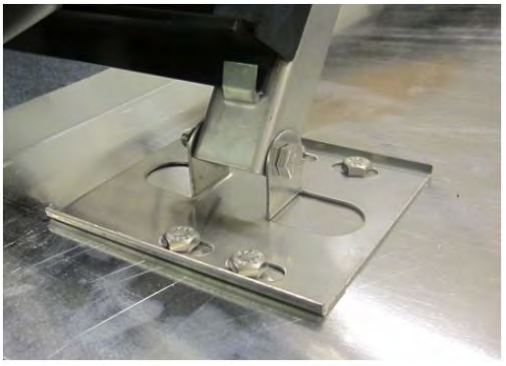
Mark these intersections where you will be anchoring the collectors to the roof.

7.6 Assembling & Mounting Frame

Step 1: Now that the roof penetration points have been marked, screw the frame along with the rubber pads into the rafters, using 3/8" x 3 1/2" stainless steel lag screws.

Note: If a angled frame kit is being used in addition to the flush mount frame, please consult the Frame Assembly Manual for instructions on assembly of the actual frame.

Rubber pads are normally used in conjunction with the flush mount frame. Depending on the roof's surface, rubber pads, stainless steel attachment straps, or round feet may be used. (Additional hardware sold separately)



Important: Zinc or Zn/Al galvanized components should ***not*** be installed in direct contact with stainless steel, as galvanic reaction between the two metals can cause premature oxidation.

Avoid using galvanized or zinc bolts to secure the frame to the root. Instead, use all stainless steel components and EPDM pads if using the angled frame. If standard corrugated iron roofing lag screws are used, they should have a rubber or nylon washer to prevent direct contact with the stainless steel frame.

Gloves should be worn when handling the metal frame, as edges are sharp and can easily cause lacerations.

It is recommended to have a foam pad or something similar for the roof, especially when the roof is steep. This will resist sliding and protect you from a hot roof.

7.7 Collector Manifold & Connections

Step 1: Attach the manifold to the now assembled frame.

The manifold will rest on the clips at the top of the frame. There are (x3) clips at the very top of the frame, which slide over the back of the manifold, and bolt into place, securing the manifold to the frame without penetrating it.

Tighten these bolts down securely, fastening the manifold to the frame.

***Important:* Do NOT install the evacuated tubes or heat pipes into the manifold at this time.**

Step 2: Make the appropriate roof penetrations, and flash the appropriate collars in place.

Now that the manifold is in place, you can determine where your piping will go. Many times, the piping is installed through the roof. If this is the case, go ahead and make the appropriate sized roof penetration, using a standard hole saw.

Using Copper Pipe: If you are using copper piping (usually ¾" diameter for residential installations), we recommend the installation of an SPP Roof Collar. These roof collars can be flashed under the current roof substrate to protect against leaks. Sweat your piping to the collars, and finish the connection to the manifold.

Using LineSets: If you are using pre-insulated line sets, we recommend using a PVC or ABS sleeve to route the LineSets. You can choose to make a single, large roof penetration to run the lineset through, or you can choose to split the lineset under the roof, and make two, smaller penetrations on either side of the collector.

Note: A 4" sleeve will accommodate LineSets that have not been split. Split sections of LineSets will fit inside a 3" sleeve.

We recommend using the appropriate size PVC sleeve glued to a 90 degree elbow. Use a rubber cap or other type of flashing that the PVC can be fit through to minimize leaking. Standard plumbing roof jacks work well for asphalt roofs, for metal roofs, look for a “Master-Flash” or equivalent brand flashing.

It is useful to locate a roof penetration location that provides the most convenient connection. Plan a penetration that misses rafters and obstructions. Have the roof jack on hand, and assure it fits the tube **BEFORE** you cut into the roof.

Step 3: The next step is routing the lines. When using copper pipe, the piping must be insulated after it has been installed. When using an un-seamed InsulTube, leave access to each pipe joint to be inspected at the first water only flush/fill. This will allow you to check the joints for any leaks.

The InsulTube pipe insulation is run throughout the entire loop. Be sure to use a suitable rubber adhesive like Nomaco K-Flex R-373 on seams and butt joints.

Continue to run the copper piping, sensor wire, and InsulTube through the attic to the heat exchanger.

The sensor wire is standard thermostat wire (18/2 AWG stranded) and is run from the controller to the roof, where a sensor will be placed in a port in the manifold.

When using LineSets, rout the lines up from where the pumping station will be located, through the building to under the roof where the collectors are located. Alternatively, if easier, you may wish to run the LineSets down from under the roof to where the pumping station will be located.

In many applications, there will be an excess of length in the LineSets provided. If this is the case, cut off what is not needed using standard pipe cutters. (See next page for cutting instructions).

With the LineSet now run through the building, under the roof you can (if making 2 penetrations as opposed to 1) split the supply and return lines. Simply pull the sensor wire carefully to unzip the insulation on one side. A sharp knife will cut the opposite side. Be careful not to cut the sensor wire.

Note that there are lines on the outer surface of one side. This is to keep track of what is supply and what is return at the connection points.

You may wish a helper to assist you in pulling up the LineSet through the hole (or holes) in the roof. Attach the union nut and stainless clip ring using the procedure detailed on the following page.

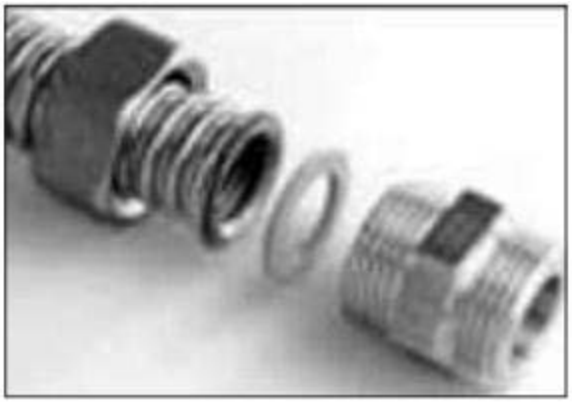
Cut pipe with tubing cutter. Do not use a hack saw.

Slide on 1" union nut and close segment ring around pipe groove.

Connect 1" nipple with 1" union nut without flat sealing washer.

Tighten 1" nipple to 1" union nut, forming a flat-sealing surface.

Remove union nipple and inspect flat-sealing surface.



Insert flat-sealing washer and connect to other fittings.

Step 4: If using LineSets, put the Fernco (or equivalent) roof cap in place. Seal off any remaining openings with roof cement. Tighten the clamp and run the panel sensor wire down through the roof.

If there is a large air gap in the PVC, you may wish to use sprayfoam insulation in conjunction with roof cement to further seal any gaps.

If using copper pipe, install the SPP roof collars (or equivalent) over the roof penetration, sliding the copper flashing under the shingles. Apply roof cement under the roof collar and the overlapping shingles, and to any remaining openings.

The roof collars are shipped in pairs, and are meant for two separate connections – supply and return. One of the collars comes with a gooseneck for the temperature sensor wire. Run the sensor wire through the gooseneck onto the roof for the sensor probe.

Repeat this process for both roof penetrations.

Before leaving the roof, double check that all connections are tight and secure. Use Fire caulk to seal any penetrations into the building envelop as per building codes.

Any LineSet piping through the attic or basement should be properly supported.

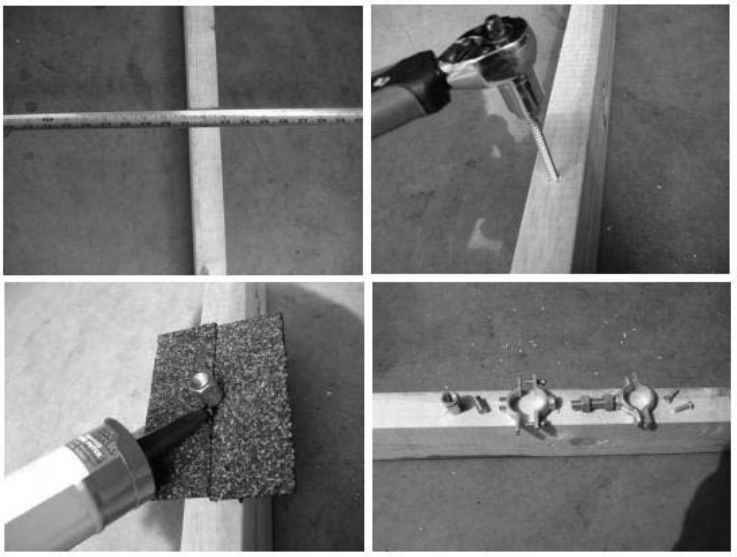
We recommend supporting the LineSets every 36 inches. Hanger kits are available for purchase in packs of 4.

7.7 Heat Dissipater & Diverting Valve Installation *(Evacuated Tubes Only)*

Heat Dissipater: Flush Mount Installation:

Step 1: Start by locating the roof truss at 16" or 24" on center. Screw in the lag bolt support.

Note: A 5/8" socket is required to screw in the lag bolt support.



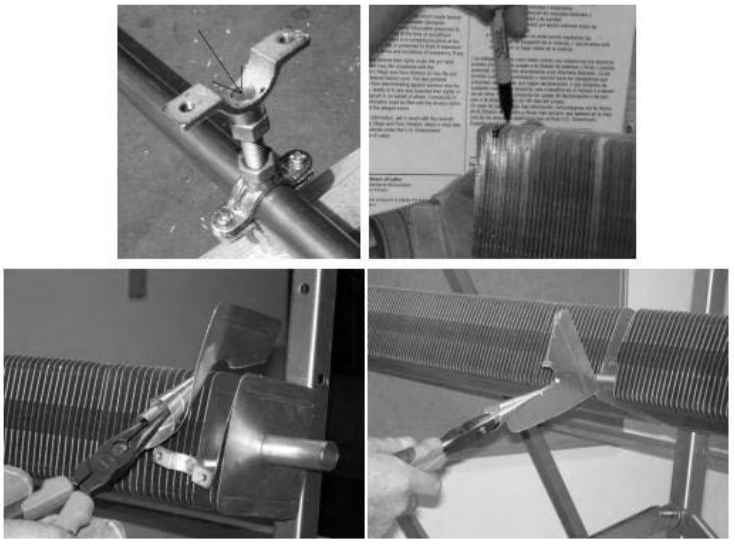
Step 2: Use proper roof sealant or cement to seal the hole and the surrounding area, to prevent any future leaks from the roof penetration.

Step 3: Assemble the pipe clamps as shown. Be sure not to screw the threaded rod too far into the pipe clamp, as this could damage the pipe.

Now that the pipe clamps are attached to the return pipe, we can attach the Heat Dissipater to the top clamps.

Step 3: Assemble the pipe clamps as shown. Be sure not to screw the threaded rod too far into the pipe clamp, as this could damage the pipe.

Now that the pipe clamps are attached to the return pipe, we can attach the Heat Dissipater to the top clamps.



Step 4: In order to attach the Heat Dissipater, you must first remove a few fins to attach the clamps. Line up the finned tube with the clamps and mark the fins that will need to be removed.

Using a pair of needle nose pliers, grab the marked fin and bend a crease in it that will allow you to twist off the unneeded fin off the pipe.

Finish by removing the unneeded fin completely from the pipe.

Now that the marked fins have all been removed, attach the dissipater to the top clamps, and tighten.

Heat Dissipater: Angled Frame Installation:

Step 1: Using the 6" length 3/8" threaded rod, thread the nut on followed by the nylon washer. Note: This rod may also be substituted with a 2 ½" bolt instead.

Insert the threaded rod into the 3rd hole from the bottom of the rear legs of the solar heating collector. Thread the bolt through the hole just enough for the thickness of the nylon washer and 3/8" nut.

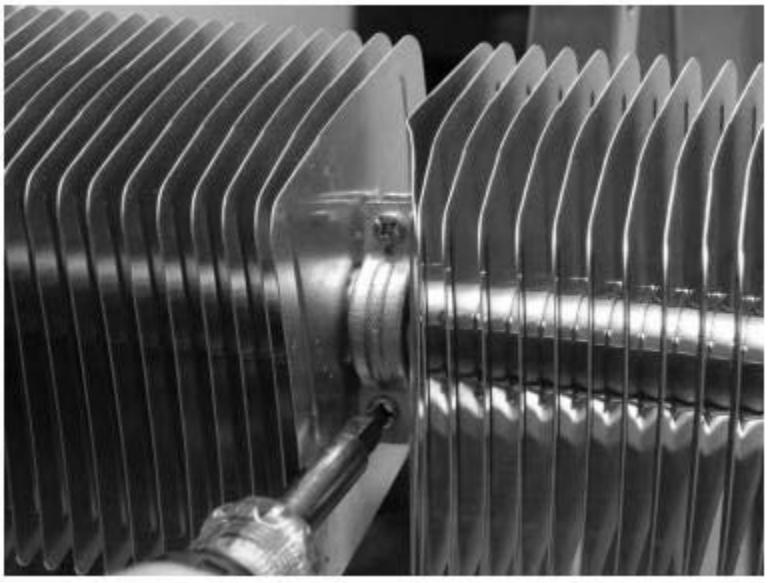
Step 2: Keep the end of the threaded rod a few threads inside the split ring clamp so you don't cut into the fin tube pipe. Now tighten the 3/8" nut so the lock washer is flat.

Step 3: In order to attach the Heat Dissipater, you must first remove a few fins to attach the clamps. Line up the finned tube with the clamps and mark the fins that will need to be removed.

Using a pair of needle nose pliers, grab the marked fin and bend a crease in it that will allow you to twist off the unneeded fin off the pipe.

Finish by removing the unneeded fin completely from the pipe.

Now that the marked fins have all been removed, attach the dissipater to the top clamps, and tighten.



Diverting Valve Installation:

A thermostatic diverting valve is used to open and close the flow to and from the heat dissipater. This is done without power, and the valve is driven by heat. Once a certain temperature inside the loop is reached, the valve will open, allowing flow through the dissipation loop.

Identify the 3 ports on the thermostatic diverting valve. These valves use standard NPT fittings. These fittings are usually ¾", however larger capacity diverting valves may have larger port sizes.

Port A should always be the hot supply from the solar heating collector.

Port B should be the return towards the solar storage tank.

Port C should connect to your heat dissipation loop.

When the solar loop is in heating mode (not dissipation mode), the fluid should flow into Port A and out Port B.

When the solar loop is in dissipation mode, the fluid should flow into Port A and out Port C.

Therefore your dissipation loop should always be connected to Port C.

7.8 Storage Tank & Pump Station Installation

Step 1: Position the storage tank in place. If you are using a storage tank that has electrical backup, ensure that the tank will be located near an appropriate electrical supply for the backup element.

Even if there is no electrical outlet, ensure there is at least a 120 volt outlet available nearby.

Step 2: Remove the components from the Solar Pump Station. This is done by sliding the spring clips out.

Step 3: Now that the components have been removed, mount the bracket and then the Pump Station to a nearby wall.

Alternatively, if you purchased the SPP tank mounting kit, you can at this point mount the pumping station directly to the tank.

To do this, locate the angle bracket in the kit and bolt it directly to the pump station bracket using the two included bolts.

Now place the angle bracket on top of the solar storage tank where you want to mount the pumping station.

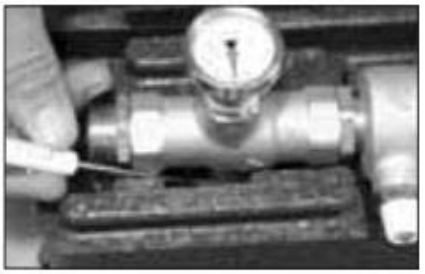
Drill 3 shallow pilot holes, then use the included self tapping screws to mount the bracket assembly to the tank.

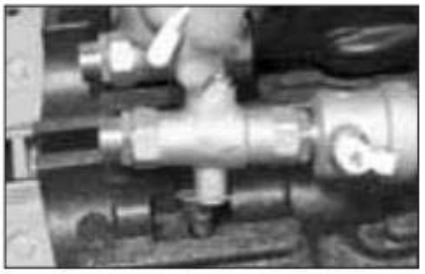
Step 4: The pump station components can now be re-assembled to the bracket. Begin by installing the rear foam cover over the brackets. Then push the two pump station assemblies onto their respective pins on the mounting bracket. A click sound will indicate the components have been securely locked onto the pins.

Step 5: Now that the solar pump station has been mounted onto the wall or onto the solar storage tank, the connections can be made.

If using copper pipe, the piping can be run and sweated onto the top fittings of the pumping station. If using LineSets, cut the lines coming in from the roof to length and install them to the top of the pumping station.

Be sure that the pipe coming off the solar panel **(hot side)** connects to the **left** side of the pump station, above the air removal & valve assembly.





Step 6: If you are using single, 6' LineSets for connection to the tank from the pumping station, locate these now. If you are using copper piping from the pumping station to the tank, these connections to the solar storage tank can be made at this time.

The bottom left connection on the pump station connects to the top coil connection on the solar tank. The bottom right connection on the pump station connects to the bottom coil connection on the storage tank.

If you are using LineSets, you may wish to shorten the lengths. If so, follow the procedure detailed on page X.

Installing elbows onto the upper and lower tank coil connections can make installing the LineSets or copper pipe much easier.

7.9 Expansion Tank Installation

Step 1: Mount the expansion tank bracket in a convenient location close to the pump station. Then connect the expansion tank to the brass double check valve. Be sure to use green washers at all connection points.

Make sure the expansion tank is mounted close enough to the pump station so the connection line in your Solar Panels Plus package will reach. Both 1.5' and 6' connection lines are available for purchase.

Step 2: Connect the expansion tank connection line ends to the pumping station and check. Remember to use washers.

The expansion tank detailed here is for the solar heating system. A separate DHW thermal expansion tank may be required on the potable water side as per plumbing codes.

7.10 Controller Installation

Step 1: Mount the iSolar controller into the pump station insulation front. The power cord for the controller routes through the lower right hole in the insulation.

Step 2: Fasten the temperature probe (lug – usually with a grey cord) into the bottom tank sensor well.

If your tank does not have a sensor well, make a small hole in the tanks insulation, and insert the temperature sensor so that the sensor is in contact with the inner metal of the tank.

Step 3: Unscrew the plate from the front of the pump. Run the 18" 'J cord' that is included in your kit through the bottom strain relief port. Connect the 3 wires into the motor.

Depending on the local electrical code, and where the pumping station is located, a heavier gage wire may need to be used. Check your local electrical code.

Step 4: Connect the other end of the 'J cord' into the controller. Connect the sensor wires from both the tank sensor and the collector sensor on the roof.

Consult the iSolar installation instructions for more details on wiring and programming your specific controller.

Step 5: Place controller into the insulation and secure with screws from the back.

You have now finished installing the basic plumbing portion of the solar heating system loop.

Double check for adequate tightening of all fitting connections at the solar tank, pump station, and solar panel connections. You are now ready to fill the solar storage tank with water, followed by adding the Heat Transfer Fluid to the solar panel loop.

7.10 Filling & Flushing

Step 1: Filling Solar Storage Tank

First, open up a hot water faucet within the home or facility. Then open the old water isolation ball valve to the solar tank. After the tank is filled, close the hot water faucet and inspect all threaded fittings and solder joints for leaks.

For a single tank system with an electrical backup element, never activate the circuit breaker controlling the heating element until the solar storage tank is completely filled with water. This will prevent "dry firing" of the heating element. The electrical heating element can be destroyed almost instantaneously if not completely submerged in water when activated. Make sure the water heater circuit breaker is off until the solar storage tank is completely filled.

Step 2: Flush & Pressure Test Solar Loop

Though the solar heating system components come capped at the ports and minimize chances of dirt getting in, you may wish to flush the system to insure dirt is not present.

A simple way to do this is simply use a garden hose with at least 30 psi pressure. First, if you have installed an air vent ball valve on the roof (also present in some flat plate collectors), ensure this is closed. Open up the two check valves on the pump station. Connect another hose to the top bib and put the end into a drain.

You may wish to put this end into a 5gl bucket so you can see if any dirt is being pushed out of the system.

Close the middle isolation valve. Turn on the water and let it run for 5-10 minutes. By this time, the water draining out of the hose should be void of air bubbles.

Close off the top bib valve. Check for leaks at all connections. Tighten down if needed. Turn off water and let the water in the loop drain back out of the top and bottom bibs. Loose the connection to the bottom of the storage tank to drain the remainder of the water, then tighten back up. Reset the two check valves on the pumping station.

7.10 Filling & Pressurizing Solar Loop

At this point, you are ready to fill the solar loop. For flat plate collectors, the loop should be pressurized to about 20 psi. For evacuated tubes, the loop should be pressurized to about 35 psi.

Step 1: Adjust expansion tank pressure to equal the solar loop pressure. The black cap spins off to reveal the appropriate valve.

Note: Most expansion tanks are typically pre-charged in the 30-60 psi range.

Step 2: To fill the solar loop, use a hose capable of handling high pressure as your fill hose. A washing machine hose usually works well. For your purge hose, we recommend using a clear hose. This enables you to see the presence of air bubbles in the glycol as it is purged from the loop.

Turn the center valve to the closed position. Connect the fill hose from the fill pump to the bottom connection and open this valve. The fluid will be pumped down through the solar tank's heat exchanger coil, back up to the solar heating panel, and back down to the return (left side) of the pump station.

Use the clear hose on the upper valve as the purge hose. Open the purge valve after connecting.

Step 3: Now you will need to mix your glycol in order to obtain the proper freeze protection. If you have ordered pre-mixed, you may skip this step.

If you have ordered glycol concentrate, you will need to mix your glycol concentrate with distilled water. Most solar heating loops will hold anywhere from 6gl to 8gl of mixed glycol.

A common ratio of glycol to water is 50/50. Consult the glycol specifications for details, in order to ensure you properly protect your system.

Step 4: Place your fill hose into your container with your glycol mixture. Place your purge hose into a large empty bucket. Turn your pump on and begin pumping into the solar loop.

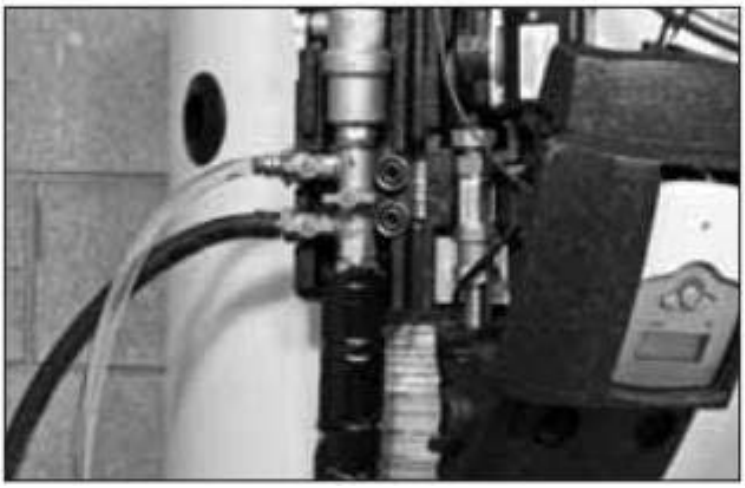
At some point during this step, glycol will begin coming out of the purge hose. At this point, place the fill hose in the drain bucket so you are pumping out of it and back into it at the same time.

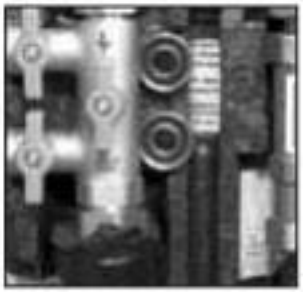
Keep circulating until a full stream is coming out and there is very little air remaining. The more air you get out during this step, the easier the next step will be.

Step 5: With most of the air in the system removed, and your pump still running, pressurize the system up to the desired value.

Now that the desired pressure has been set, close off both the fill and purge valves, and open up the balancing valve. Turn your fill pump off.

Remember to set the expansion tank pressure to the system pressure. If you need to increase the expansion tank pressure, use a hand pump or a compressor.





7.10 Purging Air

Locate the installation manual for the controller you are using. With the iSolar series controllers, they are preprogrammed to not require adjustments for many applications.

Step 1: Plug in the controller power cord. The control will illuminate. The screen will look the picture in this manual. Navigate through the items in the menu to familiarize yourself with the control.

Step 2: Scroll through the control by pressing the "+" button until it stops at the pump hours "h P" screen. Hold the "+" button for 2 to 3 seconds to enter programming mode.

Step 3: Scroll the control over to the "HND 1" menu. Push the "SET" button to change settings.

Step 4: Set it for "On" by pressing the "+" button to "On" and then push the "SET" button. The pump will then activate. Set the pump to the highest setting available.

Step 5: Manually open the air vent located in the pump station. Air should expel from here. When fluid begins to expel, close the vent.

Note: Within the next few days, when the fluid has had a chance to heat up from the sun, repeat these steps. These steps should also be repeated every 12 months or so, in order to release any air that may be trapped in the system.

Check your pressure gage to ensure your pressure is still at the desired level. If it has fallen, re-pressurize system to maintain optimal performance.

7.10 Setting Flow Rate

Now that the air is purged, set your pump flow rate. Use the site gage located under the pump to see the flow using the following guidelines:

Evacuated Tubes: 1 GPM per panel.

Flat Plates: 1.5 GPM for 1 panel, 2 GPM for 2 panels, + 1 GPM for each additional panel.

Make sure to set the controller back to Auto mode.