Solar
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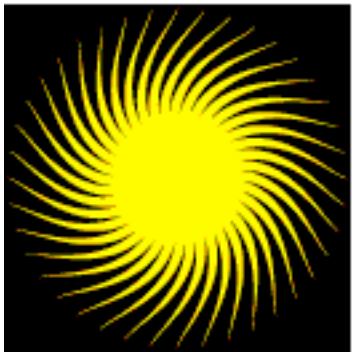


PV Pressurized Solar Water Heater

featuring Rheem Solaraide integral heat exchanger tank, and a photovoltaic-powered circulator

User's Manual

The pressurized solar water heater has the following characteristics:

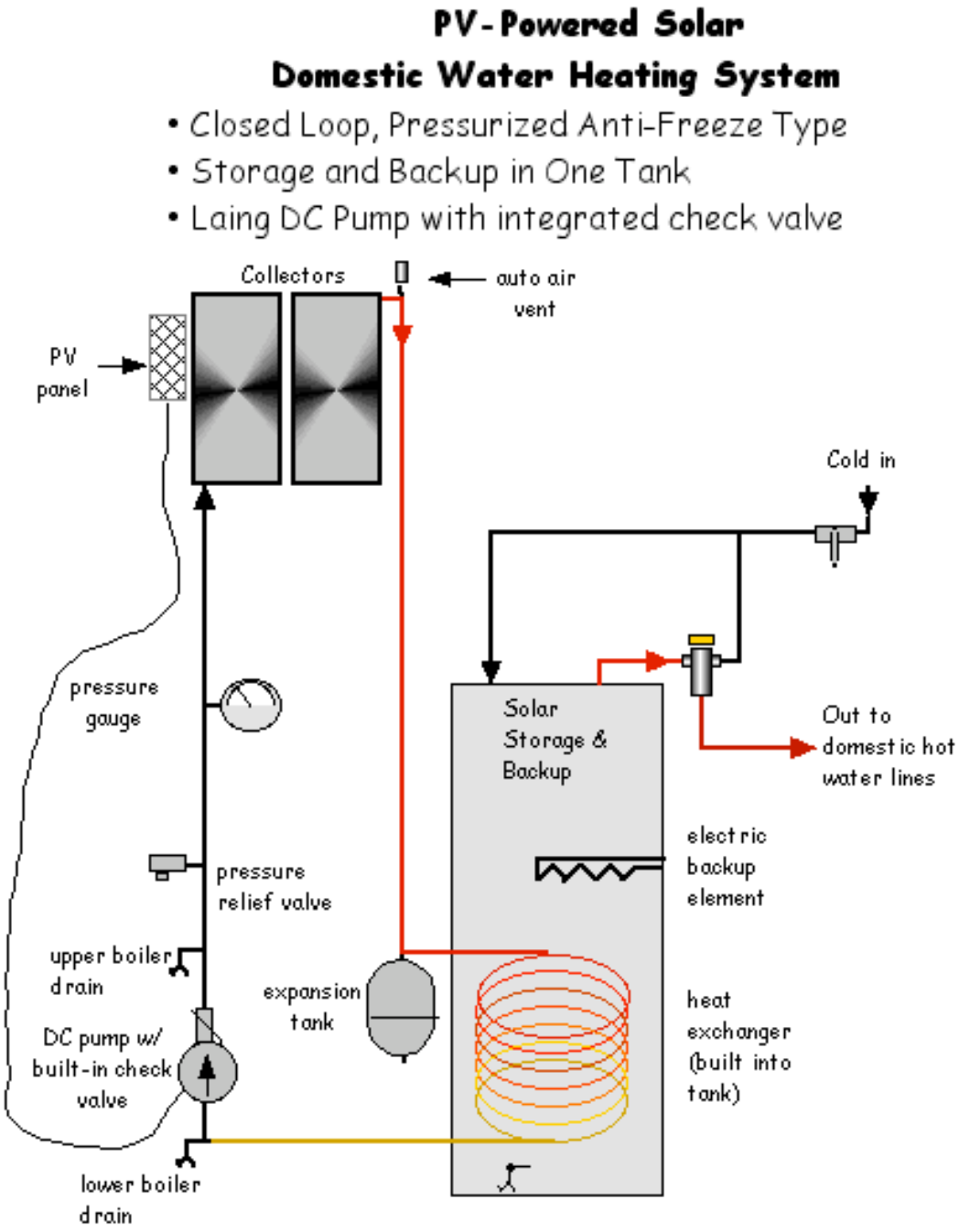
- Sealed solar fluid loop containing a solution of propylene glycol antifreeze and water.
- Heat exchanger is wrapped around the tank, so only one pump is needed.
- 12V DC circulator (pump) matched to a photovoltaic (PV) panel provides water heating even during AC electricity outage.

1. Components

The solar storage and backup water heating can be accommodated in one tank -- the Rheem Solaraide HE. (This Rheem-manufactured water heater is also sold under the Richmond and Eagle Solar brands and yours may have any one of those labels, but it is referred to in this manual as a Rheem.) The unit comes with an electric element to provide backup heating to the upper portion. [This element may be replaced by an external gas-fired heater, or a separate water heater may provide the backup in some installations.]

The solar loop of the system consists of a two drain/fill valves with a check valve between them, pressure gauge, pressure relief valve, expansion tank, 12 V DC circulator (typically a March 809 or Laing bronze pump) to move the fluid through the collectors and the Rheem water heater's heat exchanger. The solar fluid is water and propylene glycol. [It would be safe to use ethylene glycol in the system instead if desired.]

Pump	**Collector(s)**
❑ Laing D2 (w/ capacitor)	❑ SolarHot Silver
❑ Laing D5	❑ SolarHot Platinum
❑ March 809	❑ SolarGenix Winston
❑ _____	❑ AET



2. Description of Operation

The pump is controlled by the current generated by the PV panel. In strong sunshine, when the collectors are absorbing lots of heat and the PV panel is generating its peak current, the pump runs fast. At times of lesser sunshine, the pump runs proportionally slower.

The solar fluid circulates through the collectors and the heat exchanger, thereby warming the water in the lower half of the tank. As it warms, this water rises into the upper half until all the tank is heated. On a day with intense mottling of clouds and sun it is possible for the pump to stop and start several times.

By the end of a sunny day when little domestic hot water had been used the water could easily reach 130 to 150°.

At times when solar heating has not brought the top of the tank to full temperature, the backup heating thermostat will turn on the electric element or gas burner. This thermostat is behind the access panel on the water heater. [The diagram above shows the electric element as a backup. Your system may use a separate burner or tank as backup.]

3. Installation

This section is intended to inform the system owner of some of the considerations and logic that went into the installation of solar equipment. It may be helpful if a re-roofing, renovation, or other change demands part of the system be moved.

Collectors and Pipes

Your collectors may have been mounted using any of several methods, depending on whether the feet are attached directly to the collector frames or a separate aluminum frame was fabricated to hold the collectors, whether they are parallel with the roof surface or held up with legs, etc. In all cases each foot has a stainless steel lag bolt that penetrates the roof into solid wood (except for standing seam roofs, where a clamp may be used to avoid penetration), and each is sealed with a long-lasting roofing sealant.

The ideal mount faces the collector array south at approximately a 45° angle from horizontal, although the performance will not suffer greatly if they do not face due south or attain a 45° angle.

If the collectors must be moved for roof repairs consult a solar installation professional beforehand to ensure the system is shut down and drained properly and the collectors are handled properly.

4. Maintenance

The antifreeze in the solar fluid should be tested and, if needed, replaced **every five years**.

Your water heater includes an anode rod that protects it from corrosion from the potable water. It also should be checked at least every five years. If the electric element is wired up, **turn off the electric element's 240V (double) circuit breaker or pull the disconnect before draining any water or unscrewing the anode**. To check the rod, turn off the cold water inlet and drain off the hot water pressure down to the level of the top of the tank, then unscrew the sacrificial **anode rod** -- it is the large hex-head in the top of the storage tank (water heater) -- and pull it up to examine the rod. If it is deeply pitted or more than six inches of core wire is exposed at either end of the rod, replace it. After the anode is back in place and the cold-water valve is back on, open several hot water taps long enough to blow air out of the tank and lines before restoring electric power to the element.

March pumps' brushes should also be checked every five years. Laing pumps do not have brushes and require no maintenance.

The pump impeller is lubricated by the fluid it pumps and requires no maintenance, but if it ever sits a month or so without running the fluid can leave

deposits that will prevent it being able to start without being taken apart and freed up.

Some older March brand pump motors require a few drops of oil -- usually 20W, sewing machine, or light-duty motor oil -- every six months. Laing and newer March pumps use ball bearings and require no oil. Look for holes with small black tubes at the motor ends (marked "OIL") to see if your pump should be oiled. It may also be marked on the name plate, or call the pump manufacturer for details.

If the system must be left not operating for more than a few days, especially in hot weather, drain the glycol into a clean bucket and unplug the control. Most systems contain about five gallons of glycol.

Outdoor pipe insulation and caulk should be checked annually. Insulation can be damaged by animals, branches, and ultraviolet rays. If the insulation is not protected by a jacket it should be repainted with an exterior paint. All joints in insulation should be sealed. Pay special attention to sealing where insulation meets the collector or roof flashing. Also check the wire connection to the PV panel. Some panels have a permanently attached cable; others have connection boxes. If there is a box, check its integrity and seal with silicone to keep water out. Examine the cable jacket anywhere it is exposed. This should be protected from sunlight insofar as is possible.

Indoor pipe insulation should be checked every few years. Patch any areas where shrinkage or damage has caused gaps to form, using insulation rated for high temperatures (rubber foam, isocyanurate foam, or fiberglass; not plastic foam.)

Animals – indoor cats in particular – are attracted to the warmth of the system. The top of a tank makes a great place to sleep. You may have to wrap screen wire around insulation to keep them from tearing it. Most solar heating systems use propylene glycol antifreeze, which is not harmful to drink -- at least when it is new. But if your system contains ethylene glycol antifreeze instead of propylene, no pets should be allowed access to the pump area, in case of a release or leak of fluid.

5. Shut-Down

If you plan to be away from home or for some other reason no hot water will be used for days at a time, **y**ou may want to turn off the power to the backup heating element and turn off the well pump or close the whole house water supply valve, or at least close the hot water shut-off valve. Shutting down the water supply is good insurance against a water leak anywhere in the house, having nothing specifically to do with solar heating. **If no hot water is being used it is possible for the solar loop to overheat.** For safety the system includes two pressure relief valves, which open if pressure builds too high from overheating. The one on the top of the water heater can discharge a good deal of water, while the one on the solar loop can discharge a small amount of antifreeze into the drain pan. The best way to avoid this inconvenience is to cover the collector(s) with a tarp, but **do not cover or shade the PV panel**.

Should maintenance be required for the hot water tank or hot water pipes, turn off the double (220V) circuit breaker serving the water heater before draining the water. This is to protect the backup electric element from damage. After water pressure is restored and the tank is full, purge air from the potable lines before restoring electricity. PV-supplied electricity to the solar pump should be left connected even if the water tank is drained, so long as the solar fluid lines

are not disturbed. This allows the system to relieve some of its heat into the heat exchanger.

If for any reason the solar loop is taken out of service, i.e., the pump will not be running or the pipes will be cut for renovations, the glycol should be drained into a clean bucket and the collectors flushed thoroughly with water.

6. Troubleshooting

If you are ever uncertain of whether the sun is heating your water or not, try turning off the backup by switching off the water heater element 220V breaker or the pump to the gas backup. Be sure that DC power is still connected to the solar pump. Leave it this way for at least a day. You should continue to have hot water as long as there is a reasonable amount of sunshine and you are not using more hot water than the system was designed to supply. To enjoy the greatest economy, leave the backup switched off through the summer.

The best basis for troubleshooting is to become familiar with the sounds the system makes in normal operation. Also, by feeling the pipes on a sunny morning you should be able to tell a difference in the temperature of the fluid going up to the collectors and that returning. The return fluid should be warmer, although the temperature difference may be slight. But be careful: these pipes can be scalding hot!

Another troubleshooting tool is the pressure gauge. Most systems will run with as little as five pounds of fluid pressure, but were probably charged with fifteen to thirty when installed. There may be a mark on the gauge or a note written on the tank showing the original pressure. If the pressure has fallen it may be due to a pressure blowoff from overheating, a dripping drain/fill valve, a punctured expansion tank, or a leak at some other fitting or in the collectors. If the pressure is low when cold but high when hot it indicates air in the lines or a faulty expansion tank. (See next paragraph.) If the gauge is near the pump by disconnecting and reconnecting the 12VDC wire you may be able to see a slight change in pressure (2-4 p.s.i.) as the pump turns off and on. This is a good indication that the solar pump is circulating fluid. {Under any condition other than bright sunshine you will need a 12V power supply to test the pump this way.]

Pressurized systems are normally very quiet; the pump hums softly, the fluid runs smoothly. A gurgling sound from the pipes or a “popcorn popping” sound from the pump indicates air in the lines. This should be corrected immediately, as air, antifreeze, and heat combine to form corrosive organic acids that can corrode your collectors.

The pump body normally runs warm to the touch. It should never become so hot as to discolor or blister the paint, however. If the system does not seem to be circulating heat down from the collectors and the pump is hot (and possibly humming) and especially if it fails the pressure change test mentioned above, call a solar repairman. You may need to drain off some solar fluid or cover the collectors to prevent overheating until the pump is repaired.

The solar heating system is functionally independent of the backup water heating or space heating systems.

Symptom:	Likely Causes:
1) Pump never runs.	1a) Check for voltage from PV panel while sun is on the collectors. If none is present, check at PV panel to determine if the fault is in the panel, the junction box, or in the wire.
	1b) If voltage is present at pump, try substituting a 20W 12V DC power supply. If that starts pump running, some change has caused the PV to be insufficient to run the pump. If the substitution does not start the pump, then the pump should be replaced. March pump may need brushes replaced; Laing pumps have no brushes.
2) Pump hums and/or gets warm but does not circulate fluid.	2a) Pump's impeller (rotor) may be stuck. The solar fluid will have to be drained to open and free up the impeller, so this is best left to a solar repairman.
	2b) Fluid pressure may be too low for circulation. Check gauge and call us with reading.
3) Noises	3a) The pump is lubricated by the water it pumps. The noise should be a steady hum or whine, varying with the intensity of sunshine. Pinging or a soft "popcorn popping" indicates air in the lines.
	3b) Screeching or clattering indicates pump bearings are shot; disconnect one of the two wires from PV and cap off the exposed conductors. Drain the glycol from the solar loop into a clean five gallon bucket. Call a repairman. Do not let this situation go unrepaired.

4) Water not hot enough	Determine the events that cause this. Is it true all the time (in which case the tempering (mixing) valve, if installed, is suspect), only when there has not been much sunshine (in which case the backup heating is not sufficient), or only when you turn off the backup (in which case the solar may not be fully functioning)? If the problem seems to be the backup heat and this is provided by the electric element in the upper portion of the solar tank, the tank's overtemperature protection switch may have cut off. Shut off the 240V circuit breaker or disconnect to the water heater, open the access panel and locate the red button at the upper end of the thermostat. Push the red button and feel for a distinct click. If you feel that click, then you have reset the overtemperature protection. Reattach the cover and restore electricity to the element. After twenty minutes you should have hot water as usual. If that was the problem then most likely the solar was providing more hot water than you were using. On good solar days, that is, on days when your water heating is free and uses no outside electricity, you can use warm or hot water for things for which you normally use cold. It is also possible you have begun using more hot water than your system was designed to provide.

7. Notes Regarding Parts

• solar fluid pump: model 809-BR-12 , March Manufacturing, Glenview, IL or Laing Ecocirc, Laing Thermotech, Inc., 2295 Main Street, San Diego, CA 92154, phone (619) 575-7466.
• photovoltaic panel: any brand may be used. Nominal 20 Watt peak output for March pump; 10-15W for Laing.
• collector(s) typically SolarHot Gold, Platinum (Morrisville, NC) Winston Series CPC collector: (Solargenix Energy, Chicago IL) or AE series (Alternate Energy Technologies, Jacksonville. FL).
• All other parts are standard items obtainable from local plumbing supplier. If you are replacing any parts, especially the expansion tank, make certain the new part is rated for fluid temperatures >180°F.

8. Specifications

Electrical requirements: none for solar; standard backup heater element is 4500 Watt, but 6000 Watt or other size may have been installed.

Options:
• TD-6 Remote Temperature Display with six temperature readings, storage of minima and maxima.

Design changes and part substitutions may be incorporated in custom or future systems.

9. Warranty

Parts and workmanship for a complete system installed and maintained by Solar Consultants are warranted by Solar Consultants for one year from the installation date. Individual parts, especially tanks, pumps, collectors, and controls, may be covered by additional manufacturers' warranties. Solar Consultants expands those warranties to include labor for replacement of manufacturer warranted parts.

Solar Consultants warranty is void if the system has been allowed to run without fluid(s) or has been allowed to remain in a non-operating condition for more than thirty days.

Solar Consultants is not responsible for damage attributable to domestic water chemistry, including but not limited to hardness, acidity, or chloramines content.

Manufacturers' Warranties (subject to change without notice)

March pumps (March Maufacturing, Inc., 1819 Pickwick Ave., Glenview, IL 708-729-5300) are warranted for one year from date of installation and **Laing** pumps for two. (Laing Thermotech, Inc., 2295 Main Street, San Diego, CA 92154, phone (619) 575-7466).

Rheem/Richmond/Eagle Solar water heaters have six-year warranties.

Most brands of **collectors** carry a ten-year manufacturer's warranty against defects or leakage, but not against damage from freezing or outside forces. (Homeowner's insurance covers limb and storm damage.) Solar Consultants' used collectors are warranted for five years against defects or leakage.

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Glossary

Ball Valve an in-line valve that controls fluid flow. They are preferable to other types in that they do not restrict flow when open and never need a washer or seal replacement.

Check Valve an in-line valve that allows fluid to pass in only one direction.

Expansion Tank a small tank containing an air-filled bladder surrounded by fluid. As the fluid expands it compresses the air. This evens out pressure fluctuations that would be caused by temperature change.

Key Vent a bleed valve used to purge air from a pipe. It is opened with a screwdriver or square key similar to a skate key.

Pressure Relief Valve a safety valve which opens to dump fluid or water if the pressure goes beyond its set point. Sometimes the set point is adjustable; on solar loops it may be set from 30 to 125 p.s.i. On a standard water heater the PRV is combined with a temperature probe so that it can open if either pressure or temperature exceed safe limits. The outlet of the valve is sometimes piped to the drain pan, the crawl space, or outdoors.

Solar fluid The fluid consists mostly of water, mixed with an anti-corrosive buffer, propylene glycol, or ethylene glycol.

Solar loop the portion of the system that carries the fluid that passes through the collectors to be heated by the sun. This fluid is (in our systems) kept completely separate from the domestic water. Heat passes from the solar fluid to the domestic water in the heat exchanger.

Tempering Valve an automatic thermostat mounted at the hot water outlet of a water heater. If the outgoing water is above its set temperature, the valve allows cold water to mix in.