

## THE BASIC RADIANTEC SOLAR DOMESTIC WATER HEATER

“What is the use of a house if you haven't a tolerable planet to put it on?” – Thoreau



**Introduction** – The “**Radiantec Basic Solar Domestic Water Heater**” is a pre engineered “packaged” residential solar water heater that will provide abundant quantities of domestic hot water for a typical residential family.

The **Radiantec Basic Solar Domestic Water Heater** can serve as a point of departure for more versatile solar energy systems. Useful supplements such as radiant underfloor heating, solar-assisted gardening, snow melting, pool heating and passive cooling applications can be added to the basic system either initially or in the future. For clarity, however, this manual refers only to the basic water heating system. The reader is encouraged to consult with the Radiantec Company for appendices and other information about supplemental uses.

**We suggest that the reader pay particular attention to any items written in red as they will relate to safety considerations.**

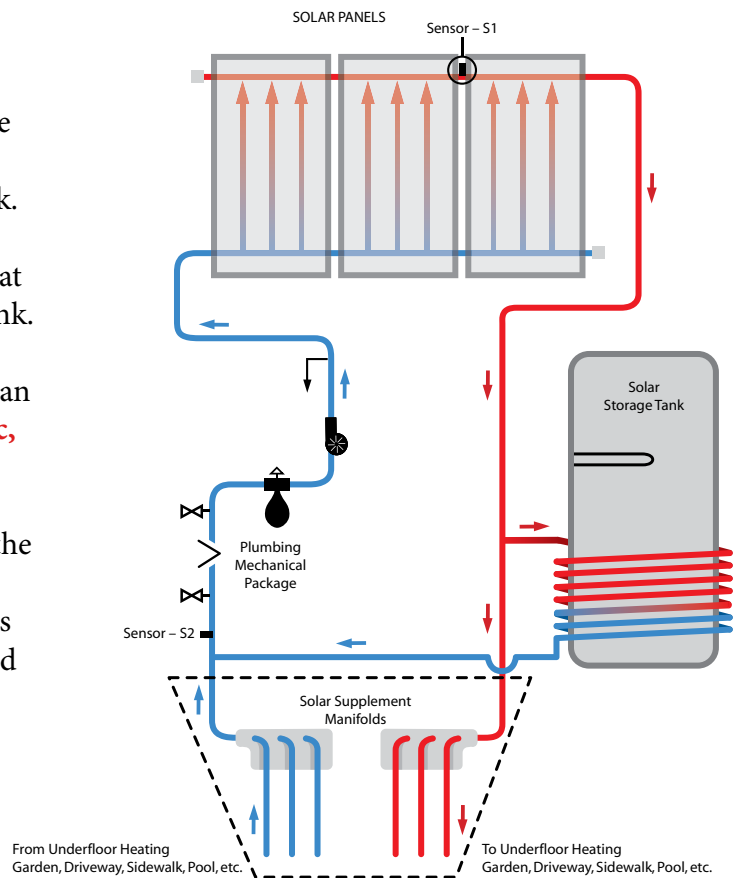
The **Radiantec Basic Solar Domestic Water Heater** is intended in part to meet the basic requirements of solar certification agencies and tax authorities.

The solar energy system described by this manual, when properly installed and maintained, meets the minimum standards established by the Solar Rating and Certification Corporation (SRCC). This certification does not imply endorsement or warranty of this product by SRCC.

**Description and Operation** – The Radiantec Basic Solar Domestic Water Heater consists of a solar collector array, a solar hot water storage tank with “wrap around type” heat exchanger, a pump, an electrical control and other mechanicals. A simple control will turn on a pump whenever the temperature inside the solar collectors is warmer than the temperature at the location where the heat will be used. When the sun comes up in the morning, the solar collectors become warm and the heat is passed to a “heat transfer fluid”, generally water or a non-toxic glycol antifreeze solution.

A thermal sensor near the solar collectors sends temperature information to the solar controller. The controller compares this information with the temperature on the pipe returning from the storage tank. If the collector temperature is warmer, the pump comes on and circulates the heat transfer fluid so that the heat energy is transferred to the solar storage tank.

The Radiantec Basic Solar Domestic Water Heater can be technically described as a **“closed loop, hydronic, antifreeze-based, indirect solar water heater** – In layman’s language, this means that a solar collector warms up a solution of antifreeze and water. Then the antifreeze solution is circulated by a pump from the solar collector to a copper heat exchanger that wraps around the bottom of the hot water storage tank, and then back to the solar collector to be reheated.



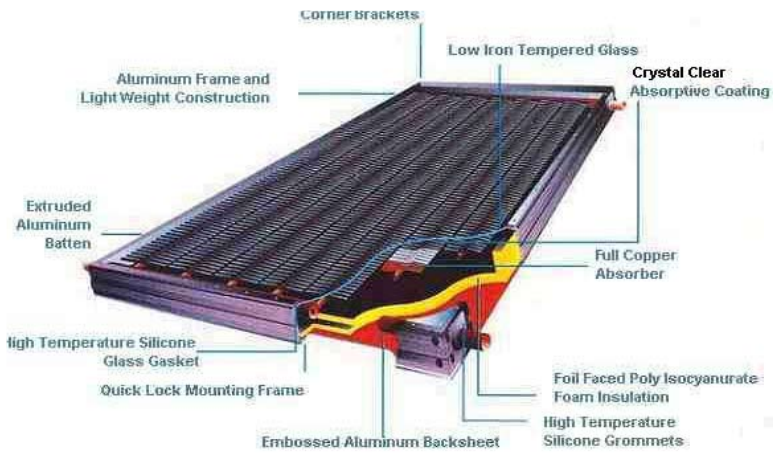
## COMPONENTS

### Solar collector array

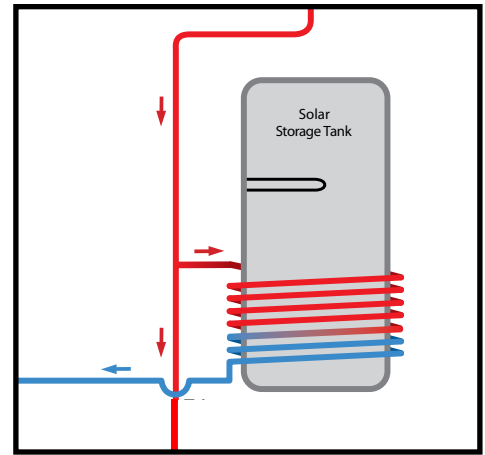
Three solar panels from **Alternative Energy Technologies** will make up the solar collector array. The model number is AE-32 and the dimensions are approximately 4’X 8’. The *net solar aperture* is approximately 90 square ft and is relatively large in comparison to many other solar collectors. The net solar aperture is the actual amount of black solar absorption area that is exposed to the sun and is a very important factor in performance.

The solar panel is a shallow aluminum box with glass cover. It is essentially a heat trap, like an automobile on a sunny day. Solar radiation passes through the glass cover into the collector where it turns into heat. The collected heat cannot escape easily by radiating back out. The heat is then carried away by a black copper absorber plate with attached fluid passages. In other words, the solar collector turns solar energy into a hot antifreeze solution.





**The solar storage tank with integral “wrap around” heat exchanger**



**The solar storage tank with integral “wrap around” heat exchanger**

The solar storage tank holds 120 gallons of potable water. It is heated by a “wrap around type” heat exchanger made of copper tubing. Heated solar fluid from the solar collectors circulates through the “wrap around” heat exchanger and the heat is passed to the water in the tank by conduction. The “wrap around” heat exchanger design gives the highest standard of protection for the potable water: Double-wall venting prevents any contamination of water in the tank.

**Back-up heating element** - An electric element is located within the top 1/3 of the tank as a backup, and it is energized whenever there is insufficient solar energy available. Its position in the top third of the tank fosters thermal stratification such that only the top third of the tank is heated electrically while the water towards the bottom of the tank remains at a cooler temperature so that solar energy may contribute to the domestic hot water need. The electric element should be set to the minimal acceptable water temperature. Some users will shut the electric element off manually at the electrical box during favorable solar conditions. In some cases, very high temperatures within the tank could trip the breaker in the tank and need to be reset by pressing the red button.

## SOLAR MECHANICAL PACKAGE



The Solar Mechanical Package contains all of the parts needed to operate a closed-loop system, including filling, draining, etc. A fuller explanation of the function of the components in the mechanical package is in the following “Installation Manual”. In a closed-loop system the solar fluid is circulated from the solar collector to the tank heat exchanger by means of a pump whenever solar energy is available. The system is said to be closed because the working fluid remains within the system and is never removed except for maintenance. **All components of the Solar Mechanical Package, including the pump, can become very hot during operation.**



## SOLAR HEAT TRANSFER FLUID

An antifreeze solution is the medium that transfers heat from the solar collectors to the solar storage tank. The solution will be a 50-50% solution of propylene glycol and water, which is non toxic (*see attached technical data sheet*).

**Freeze Protection** - The solution will prevent damage from freezing down to -50 degrees F.

**High Temperature Protection** - The antifreeze solution has a higher boiling temperature than water.

**Corrosion Protection** - The antifreeze solution has corrosion inhibitors for long service life.

**Lubrication** - The antifreeze solution serves to lubricate the pump for long service life.

**The solar fluid can be dangerously hot under certain conditions. Do not open the fill and drain valves in the “Solar Mechanical Package” if hot.**

## THE SOLAR CONTROLLER

The Radiantec Solar Controller serves several useful functions:

- Displays the temperature at important points in the system.
- Operates the pump either fast or slow according to solar availability.
- Activates a heat dump.
- Signals system malfunction.



**Solar Controller Operation** – There are two electrical temperature sensors (S1 and S2). S1 is placed where it will read the temperature of the fluid coming out of the solar collectors and S2 is placed on the piping returning from the storage tank where it will read the temperature going back to the solar panels. The controller compares the two temperatures, and if S1 is greater than S2 by a selectable amount, the pump comes on and fluid circulation begins between the solar collectors and the tank heat exchanger. When the temperature difference is small, the variable speed pump runs slowly and when the temperature difference is greater, the pump runs faster. The variable control feature has many benefits including improved low sun performance, less control cycling and conservation of electrical energy at the pump.

**The placement and insulation of the temperature sensors is a very important. Performance can suffer by 20% or more if the sensors are not installed properly. See the installation manual for more details.**



**The heat dump** - The Radiantec Solar Heat Dump is a supplemental method for controlling undesirable overheating of the solar energy system by automatically consuming some domestic hot water and sending it down the drain. The occupant can select a lower setting for the activation of the heat dump if it desirable to have lower overall temperatures in the solar system. Whenever the temperature at S1 (coming out of the solar collectors) is greater than a selectable temperature (default is 250 degrees F), the heat dump is activated.

The solar heat dump is a small solenoid type valve that sends a small 1/4" stream of water down the drain. The effect is to slowly and gently cool down the entire solar energy system without consuming very much water. The volume of a typical heat dump **is only about ten gallons** and it tends to occur twice per day if the structure is not occupied and once per day or not at all if the building is occupied. Operation of the heat dump will not compromise a septic system because of its low volume and high temperature, which facilitates bacterial action.

**Stagnation** – A solar heating system is said to be in stagnation when the solar collectors are exposed to sunlight but the heat is not being taken away and put to use. This condition can occur for any of the following reasons:

- Pump failure
- Controller failure
- Electric power failure
- An air bound system

**Under stagnation conditions, the temperature in the solar collectors may go as high as 275 degrees F and the system pressure could go to 50 psi.** As a condition of certification, solar collectors must be able to withstand prolonged periods of stagnation. Nevertheless, these very high temperatures could eventually cause appearance problems with the solar panels due to out-gassing of materials within the panel and subsequent condensation in the inside of the glass cover sheet. Also, temperatures above 250 degrees F will eventually degrade the glycol and cause it to require early replacement. Stagnation is an abnormal condition that should be corrected but it is not an emergency.

**Freezing Conditions** – The glycol portion of the Radiantec Basic Solar Domestic Water Heater will not be harmed by freezing conditions, however the solar storage tank will need to be protected if the building is unoccupied.

## **PERFORMANCE**

The variability of solar energy and also the variability in the usage patterns of the occupants means that most solar energy systems will be supplemental. Solar domestic water heaters are usually designed to provide 60-90% of the need of a typical family of four. It is generally not practical to design a solar energy system that will meet 100% of the needs under every circumstance because the overdesign needed would raise cost-effectiveness and architecture issues.

## ROUTINE MAINTENANCE AND NORMAL OPERATION

The Radiantec Basic Solar Domestic Water Heater is nearly maintenance free. Nevertheless, it should be checked periodically for normal operation. When the sun comes out, the pump should run and the system should make abundant hot water. The pump should not run at night. It would be normal for the solar system to run slowly on a cloudy day and make less hot water or hot water at a lower temperature. It is normal for the heat dump to activate for short periods of time under very sunny conditions when there is little use of hot water.

Periodic rainfall should keep the solar panels free of dirt and dust. You may rinse them off with a garden hose if they get dirty, **but do not do this when the panels are very hot.**

The antifreeze solution should be checked every two years for acidification. Normal PH is 8.6 and replacement is indicated at 7.0 or below. The antifreeze solution may last up to 25 years if it is not exposed to air.

**This simple inspection will eliminate corrosion and allow a very long service life for the system.**

Inspect the external pipe insulation periodically for UV damage and repaint as needed.

The pressure in the glycol loop as indicated by the pressure gauge should be checked periodically. It should be between 5 and 25 psi. Lower readings might indicate a leak and higher readings could indicate a stagnation condition.

### Condensation within the solar panels

It is not unusual for moisture to condense on the inside of the solar panels. Condensation can be removed periodically by allowing the system to operate at high temperatures by restricting domestic hot water use briefly. Expansion and contraction of the solar panels can draw in morning dew. Small air vents are provided on the back of the solar panels but they are not always fully adequate.

## ABNORMAL INDICATIONS AND TROUBLESHOOTING

**High or low pressure** - Low pressure in the glycol loop could indicate a leak. High pressure in the system under full sun could indicate high temperatures in the solar collectors caused by stagnation. Call for service.

**No hot water** - If there is no hot water in cloudy conditions, the reset button for the electrical element may need to be reset. Very hot water on sunny days could trip the element. If this is a nuisance, you can lower the overall temperature of the system by changing the setting of the heat dump.

**Leaks** - If there is a leak in the glycol solar loop, it will be necessary to shut down the system and drain it in order to make the repair. Call for service. **Do not perform work on a solar heating system under full sun conditions unless you are a skilled solar technician.** If there is a leak in the potable hot water portion of the system, do not make repairs under full sun conditions.

**Power failure** - A power failure during sunny periods will shut down the solar pumps and cause a no-flow situation. Temperatures within the panels will get very hot. It is not necessary to do anything. When the electrical power returns, there may be considerable noises from expansion and contraction, but normal operation should resume within a couple of minutes.

**Electrical problems** - If there is a problem with the electrical control, the system is likely to run constantly or not at all. Problems with the temperature sensors are indicated when the display flashes a high or low temperature indicates a series of dashes (-----). This indicates a short or open circuit in the sensor wiring or a defective sensor. Turn the controller to the “ON” position until it is convenient to make the repair. The solar system will run constantly until it is repaired, which will not harm the system.

## **SHUT DOWN**

It is not necessary to shut down the solar system if the building will not be occupied for a brief period of time. If no hot water will be used for more than 60 days or if the water must be shut off to the heat dump, it would be best to shut the system down by doing the following:

- Disconnect the electrical power.
- Drain the system.
- Cover the solar panels with a tarpaulin.

## **HAZARDS**

**Solar collectors can become very hot when they are in direct sunlight and no fluid is taking away the heat. Use great caution when collectors are in this condition. Do not stand near the collectors or the pressure relief valve.**

**Do not work on a solar heating system when it is in direct sunlight without covering the panels.**

**The solar heating system can generate SCALDING HOT WATER. Never send water of this temperature directly to faucets or other fixtures. Always provide an approved anti-scald valve to lower water temperature to the fixtures by mixing cold water in with the hot.**

## **WARRANTY**

Radiantec provides a limited one-year warranty on all components. In addition, many of the components carry longer manufacturer’s warranties.

## **REPLACEMENT PARTS**

Contact Radiantec for replacement parts at 1-800-451-7593.

## **SERVICE**

If the system requires service, first contact the person who installed the system. You may also contact Radiantec for contact information for a referral. 1-800-451-7593.

## **IS IT A RADIANTEC SYSTEM?**

If you have used the recommended materials and followed the directions, you have the assurances that go with a Radiantec System. These include a warranty, continued customer support and code compliance.

On the other hand, if you made important changes without our consultation, then it is not a Radiantec System. Please understand this distinction. It is not fair or legal to associate the Radiantec name with incorrect products

and designs. It is harder for us to support you if we do not know what you did.

Please understand that the toll-free customer support number is for the benefit of our customers. If you have technical or code problems with other materials and applications, we would still like to help you, but it will be as time permits and on the following number (1-802-626-8045). **Unapproved modifications to the Radiantec Basic Solar Domestic Water Heater can create an unsafe condition and might void the warranty.**



**Installation Manual – The Installation manual for the Basic Radiantec Solar Domestic Water Heater contains important information and is an essential part of this owner’s manual.**