How to get the best performance from your solar hot water system.

by Robert Edwards

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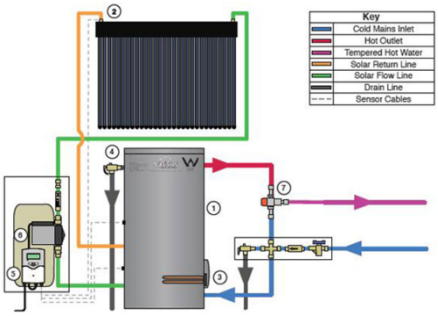
Introduction

A users guide to owning and operating the components of a solar hot water system throughout summer and winter months.

Canberra has an extreme climate range. A solar hot water system has many components and each can affect the efficiency and life of the system. This is a quick guide to help owners get the most from their solar hot water systems. There are two types of solar hot water systems. These are split systems and roof-mounted systems.

Split system solar hot water heaters

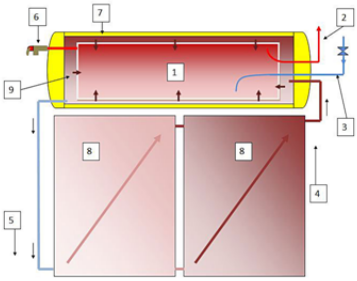


Split system hot water heaters have a tank on the ground and the collectors on the roof. A split system requires a pump to move heated water from the collectors down to the solar storage tank. It is more likely that the water in the collectors is the same water that you will use inside your home.

- Always check the solar hot water controller for error codes before winter and once every month during winter.
- It is critical that you never switch off or disconnect the power supply to the controller/pump station during winter months for more than 1 hour.
- Always check the sight glass and pump to ensure both are working before winter and once a month during winter.
- The electric booster should be on its own designated circuit. The controller must never be connected to the same circuit as the booster.
- Turn the booster off between November and May.
- Always ensure that the person you engage to repair or service your split system solar hot water systems is fully qualified.

Roof-mounted solar hot water systems





Roof-mounted systems have the collectors on the roof and the solar storage tank is installed above the collectors. No pump is required as heated water moves in a thermal current from the collectors up into the solar hot water storage tank. The water in the collectors is mixed with an anti-freeze/anti-boil liquid. Therefore, the water that moves between the tank and collectors never mixes with the water that you use inside your home.

- Turn the booster off between November and May.
- Always ensure that the person you engage to repair or service your roof mounted solar hot water systems is an expert.

Remember, with solar hot water systems, small problems can turn into big problems fast. If you suspect you have an issue, get in contact with your nearest solar hot water expert immediately.

12 signs that you may have an issue with your solar hot water system.

1. Your water pipes or solar hot water storage tank rumbles or makes a crackling sound when a hot tap is used in summer.
2. No diodes are lit and/or nothing is showing on the digital display of your solar hot water controller.
3. The solar hot water controller is showing an error code or the diodes are showing sensor faults.
4. You have no hot water in summer when the booster is off.
5. You have no hot water in summer or winter when the booster is on.

   You have to use your booster in summer when the sun is shining.

6. The solar circulating pump is switching on and off rapidly.
   The solar circulating pump is extremely hot and the flow and return pipes are cold.
7. The sight glass shows no flow rate or does not change when the pump is repeatedly turned on and off.
8. Water is running into your roof gutters when it is not raining.
9. Water is pooling around the base of your solar hot water storage tank.
10. A burning smell is emanating from your solar hot water storage tank or controller.
11. Excessive water is draining from the Pressure and Temperature Relief Valve (PTRV).
12. The insulation on your solar hot water flow and return pipes crumbles into a fine powder when your squeeze it.

Understand all of the components of your solar hot water system

The solar hot water controller for heating water (split systems)

The controller is wired to a sensor in the collectors and one or more sensors in the solar hot water storage tank. Some controllers have a digital display and some will have flashing diodes.

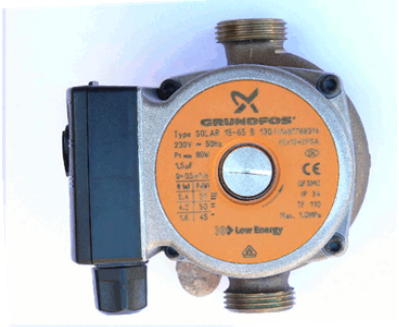
The solar controller tells the pump when to turn on and off. If the water in the tank is lower than 80˚C and it is cooler than the water in the collectors, the controller will tell the pump to switch on.

The pump should stay on until the water in the collectors is cooler than the water in the solar hot water storage tank. Once the tank temperature reaches 80˚C, the controller will stop the pump from bringing water down to the solar hot water storage tank from the collectors. This is the same controller that provides frost protection for the collectors on your roof.

Always check the controller before winter.

The solar hot water circulating pump (split systems)





The solar hot water pump moves cool water from the base of the storage tank up into the collectors to be heated, via a flow pipe. The force of the cool water entering the collectors pushes the heated water back to the solar storage tank via a return pipe. The pump does not pressurise the system. It circulates water through the system. The on/off function of the pump is determined by the solar hot water controller.

Some pumps have a pump speed setting. If possible, the lowest setting is optimal for efficiency and pump longevity. Use the sight glass to help set the speed of the pump.

Always ensure that the pump is working before winter and check it once every month during winter.

The controller for frost protection (split systems)





The controller is wired to a sensor in the collectors and one or more sensors in the tank. Some controllers have a digital display and some will have flashing diodes.

This is the same controller that controls the solar heating components of your solar hot water system. When the water in the collectors drops below 3˚C, the controller switches the pump on to circulate warm water from the bottom of the tank through the flow and return pipes and the collectors. This helps reduce the risk of freezing.

Always check the controller before winter.

The power supply to the solar hot water controller/pump station (split systems)

The controller is wired to a senor in the collectors and one or more sensors in the tank. Some controllers have a digital display and some will have flashing diodes. Controllers tell the pump when to switch on and off. It is critical that you never switch off or disconnect the power to the controller/pump station during winter months, for more than 1 hour.

The controller is the primary frost protection system for all split system solar hot water systems. Where possible, avoid switching off or disconnecting the controller during summer months.

Always check the power supply before winter. The power supply circuit to the controller should be completely independent of the power supply to the electric booster element.

The pressure and temperature relief valve (PTRV)

When water is heated it expands and increases the water pressure inside closed vessels like a solar hot water storage tank. The PTRV relieves the excess pressure that builds up inside the solar hot water storage tank when the water is being heated by the sun or booster.

This is a safety valve and must never be changed by an unlicensed person. It is normal for the valve to relieve up to a few litres per day. The hotter the day and the higher the usage, the more water will discharge from the valve.

Sight glass on solar hot water systems (split systems)

The sight glass is installed on the outlet of the solar hot water circulating pump. It indicates the flow rate of water between the tank and collectors. When the pump is on, the coloured float in the sight glass will be visible. When the pump is off, the float will not be visible. A 30 tube system should have a flow rate of 2 litres per minute.

A 20 tube system should have a flow rate of 1.5 litres per minute. On most solar hot water systems there is an adjustment screw above the glass of the sight glass fitting.

Always check the sight glass with the pump on and pump

off before winter. This can be done by switching the power supply to the controller off and on. It is best to do this when the tank is cool and the sun is shining.

Roof sensors for solar hot water systems (split systems)

The collectors have a sensor that is wired back to the controller. It tells the controller the temperature of the water in the collectors. Birds will chew the sensor wires that are exposed on the collector. The system will not produce hot water or have frost protection if the roof sensor is broken. Most controllers will have an error code or flashing diode to indicate a roof sensor/collector fault.

Tank sensors for solar hot water systems (split systems)

The tank has one or more sensors that are wired back to the controller. They tell the controller the temperature of the water in the solar hot water storage tank. If the tank sensor is broken the system will not produce hot water and may not have frost protection. Most controllers will have an error code or flashing diode to indicate a tank sensor fault.

Auto air bleed valve for solar hot water systems (split systems)

The auto air bleed valve allows air and super heated steam to escape from the collectors. These have a life of around 5 years. They will leak water onto your roof when they fail. These are not always integral to the operation of your solar hot water system.

Frost valve on solar hot water systems (flat panel split systems)

The frost valve is a back up to the frost protection provided by the controller. It will allow water to drain through the panels if the water in the panels drops below 2˚C. It is unlikely that you will find a frost valve on an evacuated tube system or tank-on-roof system. Some flat panel split systems will have more than one frost valve.

Timers for electric boosters.

When a timer is not fitted and the water in the solar storage tank is cold, the booster will come on at the same time that the sun is shining on the collectors. If this is the case, the electric booster will do the majority of the work to heat the water in the solar storage tank. This is inefficient. To get the greatest efficiency, the sun needs to do the majority of the work to heat the water in the solar storage tank.

When installed, the timer is set to allow electricity to flow to the booster at the end of the day. This is when the sun has less energy. Because the booster is also controlled by a thermostat, it will only come on if the water in the solar storage tank is lower than 65˚C.

In this case it may not need to come on at all. Or it may come on for a shorter period to lift the water temperature up to 65˚C.

The timer for the electric booster should be set for a four hour window to cater for rainy and overcast days.

The timer should be wired with a power supply that cannot be interrupted by an auxiliary switch on the booster circuit.

Electric booster on solar hot water systems (roof mounted systems)

The electric booster works independently of the solar hot water heating components and collectors. Like an electric kettle, the booster is an element immersed in the solar storage tank. When the booster is on, it heats the water in the solar storage tank. The electric booster is primarily controlled by a thermostat attached to the storage tank. The thermostat is usually set to 65˚C on solar hot water systems. The electric booster can be switched off completely between November and May.

For maximum efficiency, electric boosters should be wired to a time clock.

If you have no hot water on a sunny day and your booster is switched off it is likely that your solar hot water system requires a service

Electric booster on solar hot water systems (split systems)

The electric booster works independently of the solar hot water controller and collectors. The power supply circuit to the electric booster element should be completely independent of the power supply to the controller. The booster is an element immersed in the tank. When the booster is on, it heats the water in the tank. This is to ensure that you can always maintain frost protection should the booster trip the electrical circuit.

The electric booster can be switched off completely between November and May.

For efficiency electric boosters should be wired to a time clock.

The electric booster is controlled by a thermostat attached to the tank. The thermostat is usually set to 65˚C on solar hot water systems.

If you have no hot water on a sunny day and your booster is switched off, it is likely that your solar hot water system requires a service.

Thermostat on electric boosted solar hot water systems.

The thermostat on solar hot water systems are different to the thermostat found on a standard electric hot water system. If a timer/time clock is not installed, the thermostat is the primary controller of electricity flowing to your electric solar hot water booster. If a timer is not fitted, the thermostat will switch on the electricity supply to the electric booster regardless of whether the sun is shining or not.

The thermostat does not control the solar heating components of your solar hot water system. Therefore, it does not turn the power supply off to the electric booster when the solar controller turns the solar circulating pump on.

Gas boosted solar hot water systems

Gas boosting can be very inefficient. Gas boosting will provide hot water long after the solar hot water heating components have failed. This usually results in owners of solar hot water systems being unaware that they no longer have a working frost protection system. Gas boosting can waste a lot of water too. We do not recommend gas boosted solar hot water systems in Canberra.

Post gas boosted solar hot water systems

Flow through systems.

On flow-through systems, the water flows from the solar hot water storage tank into the gas booster. If the water in the solar hot water storage tank is cooler than required, the gas booster will ignite and will remain alight to lift the temperature of the water. If the water in the tank is sufficiently hot, the gas booster will ignite for a few seconds and then switch off. The gas booster does not heat the water that is in the solar hot water storage tank.

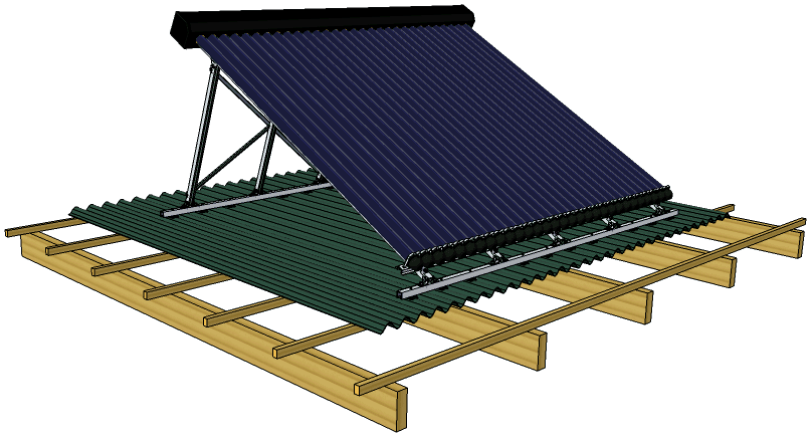
Bypass systems

On bypass systems, the water first flows from the solar hot water storage tank to a yellow-capped bypass valve. If the water in the solar hot water storage tank is too cool for use, the valve closes off the supply of water from the solar storage tank. Simultaneously, it opens to allow hot water to flow from an independent gas booster.

Immersed gas boosters on roof mounted systems and split systems.

These work on the same principle as an electric booster element and thermostat. They are the most inefficient of all types of solar hot water systems.

Pitched roof frame split systems



Pitched roof frames are an integral part of solar hot water efficiency and longevity. To gain maximum solar hot water efficiency during periods of high hot water demand (winter), the collectors should be pitched to face the winter sun. At Canberra's latitude the best angle is 45˚ – 55˚ from the horizon.

The summer sun in Canberra provides far more heat energy than is required to heat a tank of hot water. Once the water in the solar hot water storage tank reached 89˚C, the controller switches off the pump. The water in the collectors will reach temperatures in excess of 170˚C.

This extreme heat destroys sensors, melts most joint seals, degrades pipe insulation and auto air bleed valves. It causes solar hot water storage tanks and pipes to rumble when a hot water tap is turned on.

Most roof pitches are 17 – 27˚ from the horizon. This exposes the collectors to too much intense summer sun.

Collectors

There are three types of solar hot water collectors.

These are evacuated tubes, flat panel water-filled and flat panels filled with heat transfer fluid. Adding additional collector capacity without increasing hot water consumption may reduce the life of the solar hot water system. The water is heated in the collectors and is then transferred to the solar hot water storage tank via the flow and return pipes. The transfer of heated water can be via thermosiphon or it is assisted by a solar hot water circulating pump.

The solar hot water storage tank

Solar hot water storage tanks are different to standard hot water storage tanks. The solar hot water storage tank holds heated water until it is ready to be used in your home. The solar hot water storage tank may have an immersed electric element or an immersed gas booster inside.

Alternatively there may be a post gas booster hot water heater adjacent to the solar hot water storage tank.

The larger the tank, the more efficient your system will be.

Solar flow and return pipes

The solar flow pipe is used to transfer cool water from the base of the solar hot water storage tank to the collectors. The water is heated in the collectors and then returns to the solar hot water storage tank via the solar hot water return pipe. It enters the solar hot water storage tank via the return connection which is usually slightly higher than the flow pipe connection. These pipes are insulated to prevent heat loss. Both roof mounted system/thermosiphon and pumped split systems have solar flow and return pipes.

About The Author

Robert Edwards is the Head Solar Hot Water Technician for Canberra Solar Hot Water Repairs, Canberra Hot Water Repairs and 6 Star Hot Water and Plumbing. These businesses specialise in helping home owners, businesses, non government and government agencies to obtain the lowest operating costs for their solar hot water systems.

Robert has more than 30 years hot water experience in Australia's Alpine regions. He is a licensed plumber and gas fitter with a restricted electrical license. He is recognized as a solar hot water expert by the top 4 Australian hot water brands. He has been a director of Master Plumbers Australia and board member of Master Plumbers ACT.