Apricus Solar Hot Water

Owner's Operating and Maintenance Manual

For Domestic Hot Water Systems

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CHAPTER 1: INTRODUCTION

1.1 TERMINOLOGY

- Bank: Multiple collectors in series (one after the other).
- Boost: The process where a heating component (such as an electric element or gas heater) is used to provide additional heating when solar-heated water is not of an adequate temperature
- Clean Energy Regulator (CER): Government body responsible for overseeing the implementation of the Large-scale Renewable Energy Target (LRET) and the Small-scale Renewable Energy Scheme (SRES).
- Collector: The Apricus solar collector includes the manifold with heat pipes and evacuated tubes inserted.
- Expansion Control Valve (ECV): Installed on the cold mains line to relieve excess pressure.
- Expansion Tank: Fitting an Expansion Tank to the system allows the water to move into the expansion tank and occupy its volume, rather than increasing the system pressure. This reduces the wastage of water through the PTRV and protects the system from high pressures and undue wear.
- Evacuated Tube: functions to harness the solar energy by capturing and retaining the heat due to the presence of the vacuum.
- Flow Line: The plumbing line running from tank solar flow port to the inlet of the collector. This line incorporates the circulation pump.
- Heat Pipe: A copper pipe that sits inside the evacuated tube and is inserted into the collector manifold. A small volume of liquid acts as a heat transfer fluid. It absorbs heat via evaporation, and transfers heat to the system fluid via condensation.
- Header Pipes: The copper “heat exchanger pipes” in the manifold of the Apricus collector through which the water flows.
- Insolation: solar radiation level, expressed in kWh/m2/day.
- Manifold: Refers to the solar collector enclosure that contains the header pipes.
- Pressure Temperature Relief Valve (PTRV): installed on the hot water storage tank to relieve pressure, and excessive temperatures.
- Return Line: The plumbing line running from the solar collector to the solar return port on the tank.
- Stagnation: Stagnation is the maximum temperature a collector will reach, at which point the rate of heat gain and rate of heat loss is balanced.
- Stratification - the passive separation of water into distinct layers of different temperatures; where the temperature at the top of the tank can be significantly higher than the temperature at the bottom.

1.2 SCOPE

This manual has been designed to provide installation instructions for the installer or plumber.

UNDERSTANDING WATER HEATING

Before explaining the operation of your hot water system is it important for you to understand how water heating works.

When you open a hot water tap, water pressure forces hot water out of the storage tank. When this happens cold water is actually entering the bottom of the hot water storage tank, gradually allowing the hot water in the tank to be pulled up and out.

The water is separated into hot and cold layers, this is primarily due to the fact that heat rises. See Figure 1. This is referred to as stratification and is very important as it allows us to use nearly all of the hot water available in the tank. You can experience this when having a shower when the water suddenly turns cold, this occurs when all of the hot water has been drawn out.

In order to prevent scalding due to excessively hot water, most new houses have a tempering valve installed. If you are in an older house the plumber should advise that you install a tempering valve. This is an important safety device, as it limits the water supplied to the hot water taps to be no more than 50oC. Although this temperature is quite hot, it will not cause burns. Hot water leaves the storage tank and passes through the tempering valve which brings the temperature down to 50oC by mixing with cold water. At the shower most people will then cool it down further by mixing with more cold water.

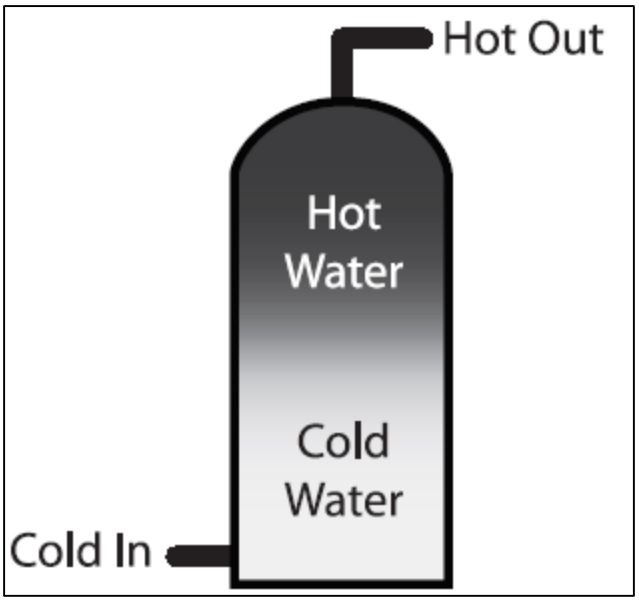

Figure 1 Diagram showing the stratification of hot and cold water within a storage tank.

HOW SOLAR WATER HEATING WORKS

Apricus solar water heating is done by using a solar collector which is a thermal solar heating device. By gaining a basic understanding of your solar hot water system you can develop realistic expectations about the operation of the system, develop habits that maximize energy savings and most importantly, ensure safe and reliable operation.

An Apricus solar hot water system captures solar energy directly and converts it to heat for use in your home.

1. The evacuated tubes ensure maximum absorption of the sun's energy and convert it to usable heat.
2. The heat inside the evacuated tube is carried via copper heat pipes to the insulated manifold (head of collector) that contains a copper heat exchanger.
3. A controller measures the temperature of the water in the manifold and compares it to that in the bottom of the storage tank. If the manifold temperature is higher, the controller switches on a circulation pump that brings the solar heated water back down to the storage tank.

THE EVACUATED TUBE

1. Sunlight strikes the dark absorber coating inside the evacuated tube.
2. The heat pipe transfers the heat up to the copper header pipe location in the insulated manifold box.
3. The vacuum in the tube acts the same as a thermos flask, keeping the heat inside and ensuring it is delivered to the water, not lost to the air. Though the glass may be cool to the touch, inside, the system may be reaching temperatures up to 100°C. Refer to Figure 2.

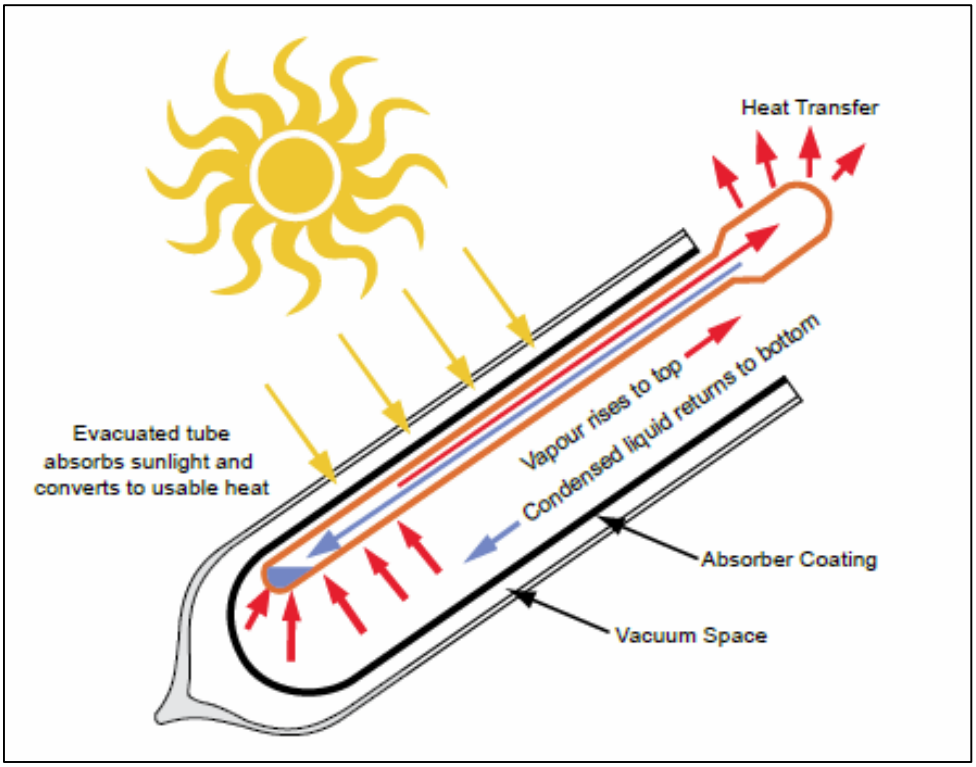

Figure 2 Evacuated Tube Function

SYSTEM PERFORMANCE

The solar hot water system will begin acting immediately after installation to reduce your energy costs. System performance is dependent on the available sunlight that falls directly onto the collector. This means that during the months of winter when the sun is in the sky for fewer hours the solar contribution will fall. Conversely, the performance of the solar hot water system will increase significantly during summer to off-set the greater majority of your hot water usages all year round.

UNDERSTANDING SOLAR CONTRIBUTION

Some home owners make the mistake of thinking that once they install a solar water heater, they can turn their element or gas booster off whenever there is sunlight. This is incorrect for two reasons.

Firstly it is a requirement to heat the water on a regular basis to kill Legionella bacteria, see specific heating requirements in Chapter 3: System Operation. Secondly, solar radiation is only half or one third as strong in the winter months compared to summer, and therefore is not able to provide the same amount of hot water as in the summer.

CHAPTER 2: SYSTEM COMPONENTS

The system components that are a part of the electric and gas solar hot water systems are depicted and tabulated in Figure 3 and Table 1, and Figure 4 and Table 2, respectively.

TYPICAL ELECTRIC BOOSTED SYSTEM

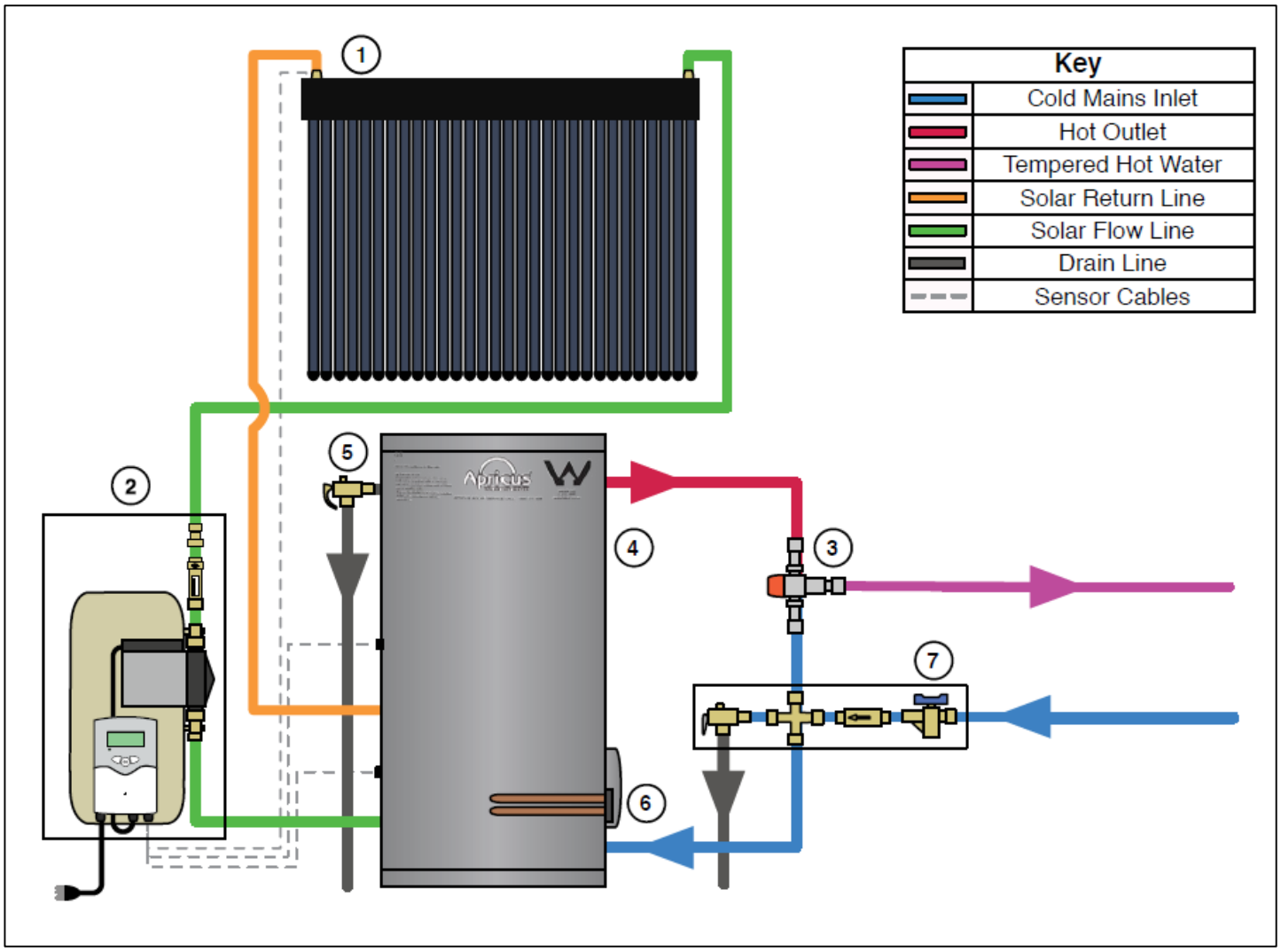

Figure 3 Typical Electric boosted solar hot water system.

Table 1 Components that make up a typical Electric boosted solar hot water system.

No.	Component	Function
1	Evacuated tube collector	Solar energy collection
2	Circulation Pump	Circulates water from the tank to the manifold
	Controller	Monitors temperatures and controls the system
3	Tempering Valve	Tempers the hot water down to a safe outlet temperature
4	Tank	Stores hot water for when you need it
5	PTRV	Pressure Temperature Relief Valve
6	Electric Element	Provides a backup energy source for cloudy days and legionella protection
7	Mains line valves	Duo valve, cold water expansion control valve, pressure reducing valve, four way cross

TYPICAL GAS BOOSTED SYSTEM

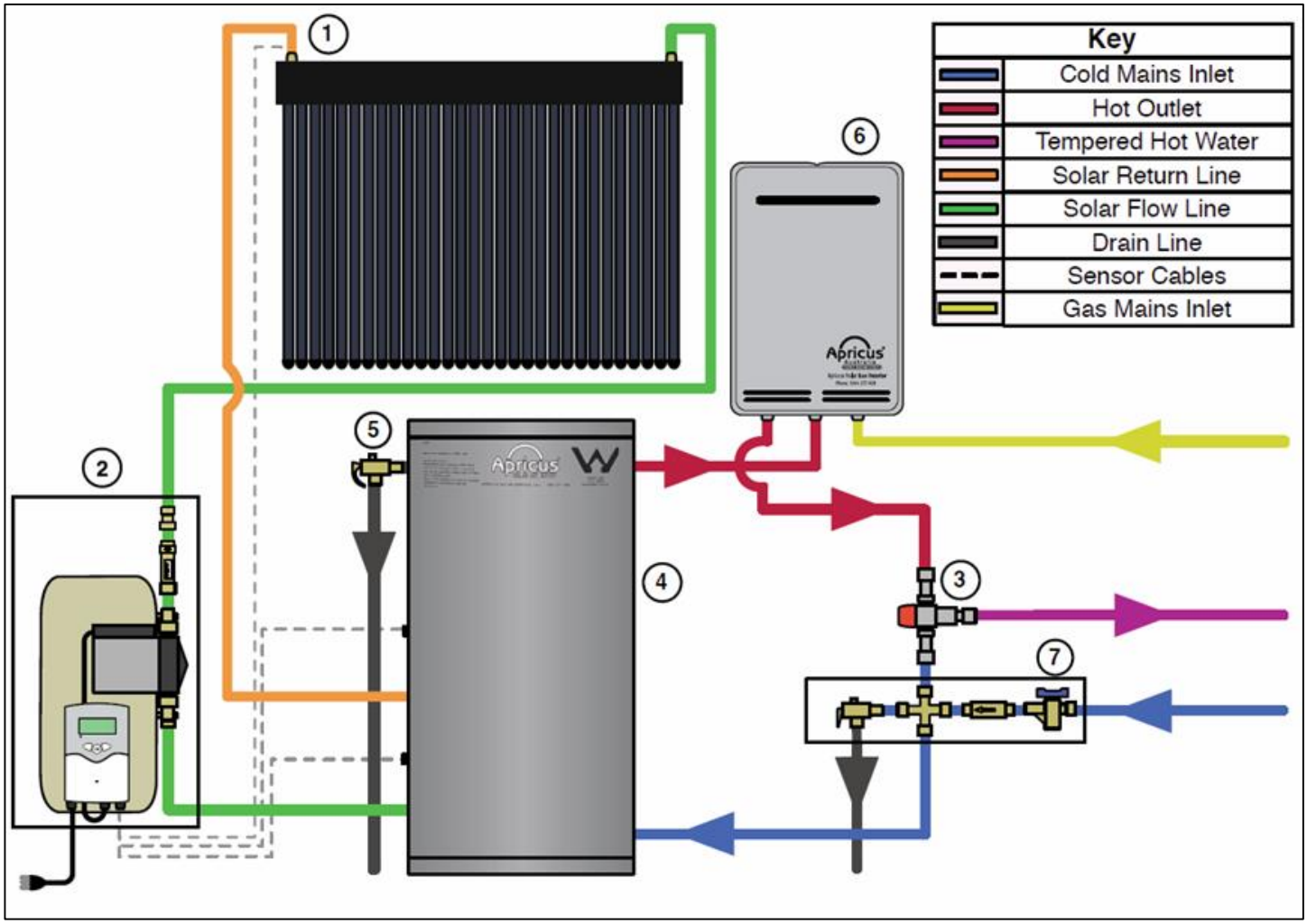

Figure 4 Typical Gas boosted solar hot water system.

Table 2 Components that make up a typical Gas boosted solar hot water system.

No.	Component	Function
1	Evacuated tube collector	Solar energy collection
2	Circulation Pump	Circulates water from the tank to the manifold
	Controller	Monitors temperatures and controls the system
3	Tempering Valve	Tempers the hot water down to a safe outlet temperature
4	Tank	Stores hot water for when you need it
5	PTRV	Pressure Temperature Relief Valve
6	Gas Booster	Provides a backup energy source for cloudy days and legionella protection
7	Mains line valves	Duo valve, cold water expansion control valve, pressure reducing valve, four way cross

CHAPTER 3: SYSTEM OPERATION

PUMP OPERATION

The Apricus solar hot water system is powered by a small circulation pump, installed beside the tank, which consumes less power than a small light bulb. It turns on and off at varying intervals that are determined by the controller and its temperature sensors. When the temperature difference between the tank and the roof are at just the right temperatures the pump will extract the optimum amount of energy from the collector and transfer it into your hot water tank.

On cold nights the circulation pump may turn on to cycle water from the hot water tank into the collector to prevent the components on your roof from freezing.

AUXILIARY BOOSTING OPERATION

The auxiliary boost acts as a back up to ensure you always have hot water ready to go, so even when the sun is hiding you and your family are still able to have a hot shower. Secondly, it provides protection against the growth of legionella bacteria that can lead to legionnaire's disease. The temperature requirements and frequencies of heating are in Table 3 below.

Table 3 Minimum heating requirements of different system types.

Type of Apricus system installed	Minimum heating requirements
Glass-lined Bottom element electric boosted system	Once per week to 60°C for 32 minutes
Middle element electric boosted system	Once per day to 60°C
Gas boosted system	Boosting to 70°C if incoming water is less than 55°C each time water is used

ELECTRIC ELEMENT

Electric element tanks have an element inside them located near either the bottom, or the middle of the tank. This element operates just like a normal electric hot water system; only the amount of work is reduced due to the solar input from your collectors.

Middle element tanks should generally be connected to continuous power to ensure hot water demands are satisfied even when there is low solar insolation. Bottom element tanks may be connected to off-peak power tariffs to reduce energy bills whilst still meeting larger morning hot water loads.

GAS BOOSTER

Gas boosters are located after the hot water storage tank. For an Apricus gas booster, if the incoming water temperature is less than 55°C, the booster will activate and heat water to 70°C. If the incoming water is greater than 55°C the booster will not start and water will flow directly to the outlets. Under normal operations the gas booster may fire-up on the first instance because there may be cold water in the pipes between the storage tank and itself.

CHAPTER 4: IMPORTANT FEATURES & CHARACTERISTICS

PTRV

A PTRV is installed on the hot water storage tank to relieve pressure, and excessive temperatures in the system. The PTRV discharges 3-6% of the water heaters capacity during normal heating cycles with a hot water system.

The maximum allowable PTRV water discharge as per AS/NZS 2712 is roughly 10% of tank total volume for an Apricus Australia solar DHW system.

EXPANSION CONTROL VALVE (ECV)

An ECV is installed on the cold water inlet of some water heaters to relieve pressure within the system. The ECV may discharge a small quantity of cold water rather than the PTRV discharging hot water from the tank. This conserves hot water within the storage tank, as the discharged water from the ECV is much cooler than the PTRV.

SYSTEM FROST PROTECTION

The controller has a safety mechanism that operates the circulation pump when the temperature in the collector falls below 4^{o}C. Cycling water from the tank increases the temperature of the collectors to prevent the water in the collectors from freezing.

HOLIDAY MODE

If you are going away for a long period of time your system is capable of protecting itself with the existing safety devices (i.e. ECV, PTRV, Frost Protection mechanism). If your system is electric boosted you may want to switch off your element at the switchboard to save energy, whilst leaving the controller turned on.

SHUT DOWN MODE

During the months of summer you may experience days of hot weather and your solar hot water system may have the potential to generate more hot water than you would be using. When this is the case, the controller will detect that your storage tank is full of hot water and request the system to shut down. During these times the circulation pump will be inactive until you use a substantial amount of hot water from the storage tank and the solar collectors cool down.

CHAPTER 5: TROUBLESHOOTING

You may encounter abnormal characteristics with your solar hot water system and would like to understand the issue to avoid a service callout from your local plumber/installer.

PTRV

The PTRV relieves 3-6% of the water heaters capacity during normal heating cycles with a hot water system. If the storage tank is discharging more than a bucket full of water in 24 hours, it may be due to the incoming water pressure being too high. Request for your plumber/installer to fit a pressure limiting valve.

There could be some debris or thread seal tape trapped in the valve mechanism. You can try lifting the valve gently and try to dislodge anything that could be causing that valve not to be re-seating properly. Please refer to Maintenance Procedures provided in Chapter 6: System Maintenance.

WE DON'T HAVE ENOUGH HOT WATER

Solar collectors work based on weather, when the sun is not shining as bright in the sky your system will require the auxiliary heater to operate to provide the hot water (ensure that this is functioning correctly). Installing a solar hot water system doesn't mean you get more hot water; it harnesses the sun's energy to offset the load from your conventional heat source (electricity/gas) as much as possible.

You may be using more hot water than you realise. Look more closely into how you are using hot water around the home. Adjusting your hot water usage patterns to maximize the energy that your system can generate during the day will benefit your energy bills.

CIRCULATION PUMP

Table 4 Circulation pump related issues

Symptom	Potential Cause	Solution
Pump is not operating even during sunny weather.	Storage tank is already full of hot water.	This is normal operation. Controller switches pump off once maximum temperature is reached to prevent over-heating.
	Collector is at a very high temperature.	This is normal operation. Pump will not circulate until the collector temperature is safe.
	Controller/pump power is OFF.	Connect power to controller/pump.
Pump appears to be running but collectors not cooling down.	Air lock in system	Ensure system pressure is 2-6 bar. Drain and refill the system.
	Flow rate is too small. Pump is undersized for given pipe length.	Solar pumps are sized suitably for a total pipe run length of 100m. May require a larger pump to get higher flow rates.
Pump is running overnight.	Frost protection is operating.	This is normal operation. Pump will be activated to circulate tank water to the collector to prevent collectors from freezing.
	System is reverse thermos-siphoning.	Check with the plumber that a U-shaped heat trap on the solar return line piping has been made and if it has not then it is advised to have a non-return valve on the solar return line installed.

CONTROLLER

The controller provides indicators that can assist you in understanding what the system is doing. Refer to Table 5 below for symbols that may appear on the controller display related to Chapter 5: Troubleshooting.

Do not change any controller default settings.

Table 5 Apricus Controller symbols and descriptions

Controller Symbol	Description	Action required?
☼	Maximum store temperature exceeded: TST Bottom tank temperature will read 75°C. Pump will not be active until hot water is drawn or tank cools down.	This is normal operation.
⚠ (flashing)	Collector emergency shutdown active: COL will read ≥ 110°C. Pump will not be active until collector cools down.	This is normal operation.
❄ (flashing)	Frost protection is operating. Pump will be activated to circulate tank water to the collector to prevent collectors from freezing.	This is normal operation.
🔧⚠ (flashing)	Sensor defect: 888.8 indicates the fault is a broken cable, -88.8 indicates that there is a short circuit.	Contact the Apricus Aftersales Team.
Display off	Controller may be in standby, press main circular button to see if display illuminates. Controller power may be off.	Connect power supply to controller if it is off.

IF YOU HAVE READ ALL THE INFORMATION WITHIN THIS MANUAL AND BELIEVE THAT YOU NEED ASSISTANCE, CALL APRICUS AUSTRALIA'S AFTERSALES TEAM.

CHAPTER 6: SYSTEM MAINTENANCE

Apricus recommends that maintenance must be carried out accordingly with but not limited to the maintenance schedule in Table 6. Please refer to the manufacturer's documentation for any non-Apricus components for maintenance guidelines. Maintenance and servicing should only be completed by a certified plumber, with experience in solar hot water systems.

Table 6 Suggested Maintenance Schedule

MAINTENANCE SCHEDULE	MAINTENANCE PERIODS			
	EVERY 6 MONTHS	EVERY 12 MONTHS	EVERY 2 YEARS	PER PRODUCT GUIDE
SOLAR COLLECTOR				
All tube clips are present and secure		X		
All tube caps are present		X		
All tubes have vacuum. Check tubes are intact and bottom is silver. Replace if broken. If dirty, clean with glass cleaner (if safe)	X			
Manifold and frame are free of rust			X	
Inspect manifold			X	
Descale collector loop or install scale inhibitor			X	
Check that there is no shading on collector.		X		
EXTERIOR PIPING				
All piping is insulated, with no exposed pipe	X			
All insulation is free from defects	X			
All insulation is UV and weather protected		X		
Insulation jacketing is free of degradation		X		
Check pipe hangers are in good condition		X		
Piping is labelled clearly			X	
Inspect brass fittings		X		
INTERIOR PIPING				
All solar piping is insulated			X	
All hot water piping is insulated			X	
All piping is labelled clearly			X	
Check pipe hangers are in good condition			X	
All valves are clearly labelled			X	
Inspect brass fittings		X		
SYSTEM				
Check that the pump is operational				X
Check expansion tank (if applicable)				X
Check that the differential control is operational		X		
STORAGE TANK				
Drain and flush tank				X
Inspect anode rod (if glass-lined tank)				X
Inspect tank		X		
VALVES				
Check PTRV operation		X		
Release PTRV lever to prevent debris build up.	X			
Check tempering valve operation, that the line strainers are clear and that the pressure across tempering valve is balanced.		X		
GAS BOOSTER				
Inspect gas unit for insect infestations and plant growth, remove	X			
ELECTRIC ELEMENT				
Inspect element for leaks. Check fuse, replace if required	X			

MAINTENANCE PROCEDURES

SOLAR COLLECTOR

If a tube is broken it should be replaced as soon as possible to maintain maximum collector performance. However, the system will continue to operate safely with a damaged tube. Any broken glass should be cleared away to prevent injury.

To replace a tube:

1. Remove the tube clip, slide the broken tube out and carefully pick up any glass pieces and dispose of appropriately.
2. Avoid touching the glass wool insulation inside the manifold with bare hands, as it can cause mild skin irritation.
3. If the heat pipe is not damaged, it can be left in place and a new evacuated tube inserted, guiding the heat pipe down the groove between the evacuated tube inner wall and heat transfer film.

Note that the tubes are self-cleaning. However it is possible to clean the tubes in the following ways:

1. Wipe down glass exterior with a wet cloth
2. If particularly dirty, use a glass cleaner and wipe the glass exterior (only if safe to do so).

DRAINING THE SYSTEM

Draining of the collector and/or tank may be required when servicing or performing maintenance on the system. Periodic flushing of the system is not required unless in areas with hard water resulting in scale formation in the bottom of the tank.

WARNING
Allowing the collector to sit pressured with isolation valves closed may lead to dangerously high pressure.

Follow the steps below to drain the collector:

1. Turn off the cold mains water supply to solar storage tank.
2. If the storage tank is being drained,
    a. Disconnect all power supply to water heater.
    b. Release pressure in the tank by carefully operating the PTRV release lever.
    c. Undo the cold inlet and attach a drain hose.
    d. Operate the PTRV release lever allowing air into the heater and water to drain via the hose
3. If the storage tank is not being drained
    a. Isolate piping to and from the solar collector and immediately undo fittings to open drain line
    b. Open up the drain outlet on the solar return line to allow air to enter the system.
    c. Allow the manifold to sit in a vented state for 5-10min to allow itself to boil dry (may need longer in poor weather).
    d. Close the drain when draining is complete.
4. Re-fill the system by following the procedure outlined in the Apricus DHW Installation manual, Chapter 7: Commissioning.

AIR LOCKS

If the pump is running but flow is not being achieved in the solar loop, the system may have an air lock. An air lock can be rectified by following the filling procedure outlined in the Apricus Installation manual in Chapter 7: Commissioning.

OVER PRESSURE PROTECTION MAINTENANCE

The lever on the PTRV should be carefully lifted and placed down once every 6 months, this will help prevent any debris of scale build up in the valve. Ensure the drain pipe from the PTRV is clear.

This should be similarly done for the expansion control valve on the cold mains line (if there is one installed).

MAGNESIUM ANODE REPLACEMENT

Glass lined storage tanks have a magnesium anode inserted into the tank. The anode prevents internal corrosion that will otherwise drastically shorten storage tank life. Apricus recommend the anode be inspected at least every three (3) years, and serviced as required. Inspect the anode on a yearly basis if tank uses hard water.

It is recommended that the manufacturer be consulted regarding suitable replacement anodes.

WARNING

If the hot water system is not used for two weeks or more, a quantity of highly flammable hydrogen gas may accumulate in the water heater. To dissipate this gas safely, it is recommended that a hot tap be turned on for several minutes or until discharge of gas ceases. Use a sink, basin, or bath outlet, but not a dishwasher, clothes washer, or other appliance. During this procedure, there must be no smoking, open flame, or any electrical appliance operating nearby. If hydrogen is discharged through the tap, it will probably make an unusual sound as with air escaping.

CHAPTER 7: GENERAL INFORMATION

WARRANTY/SERVICE CALL

If you have an issue with your Apricus solar hot water system please contact our head office on:

1300 APRICUS (1300 277 428)

SYSTEM REGISTRY

Registering your Apricus solar hot water system will ensure that your details are placed on our computer system streamlining any future after-sales/service requirements. You can register your Apricus Australia solar hot water system online at: www.apricus.com.au

STAY IN THE LOOP

To stay up to date with the latest Apricus news, product updates, announcements, and specials. Sign up to our Apricus e-newsletter and connect with us on social media by visiting our website: www.apricus.com.au