Sussex Solar

Sun-powered hot water

Solar System
Evacuated heat-pipe collector
Unvented hot water cylinder
Owners Manual

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System Overview

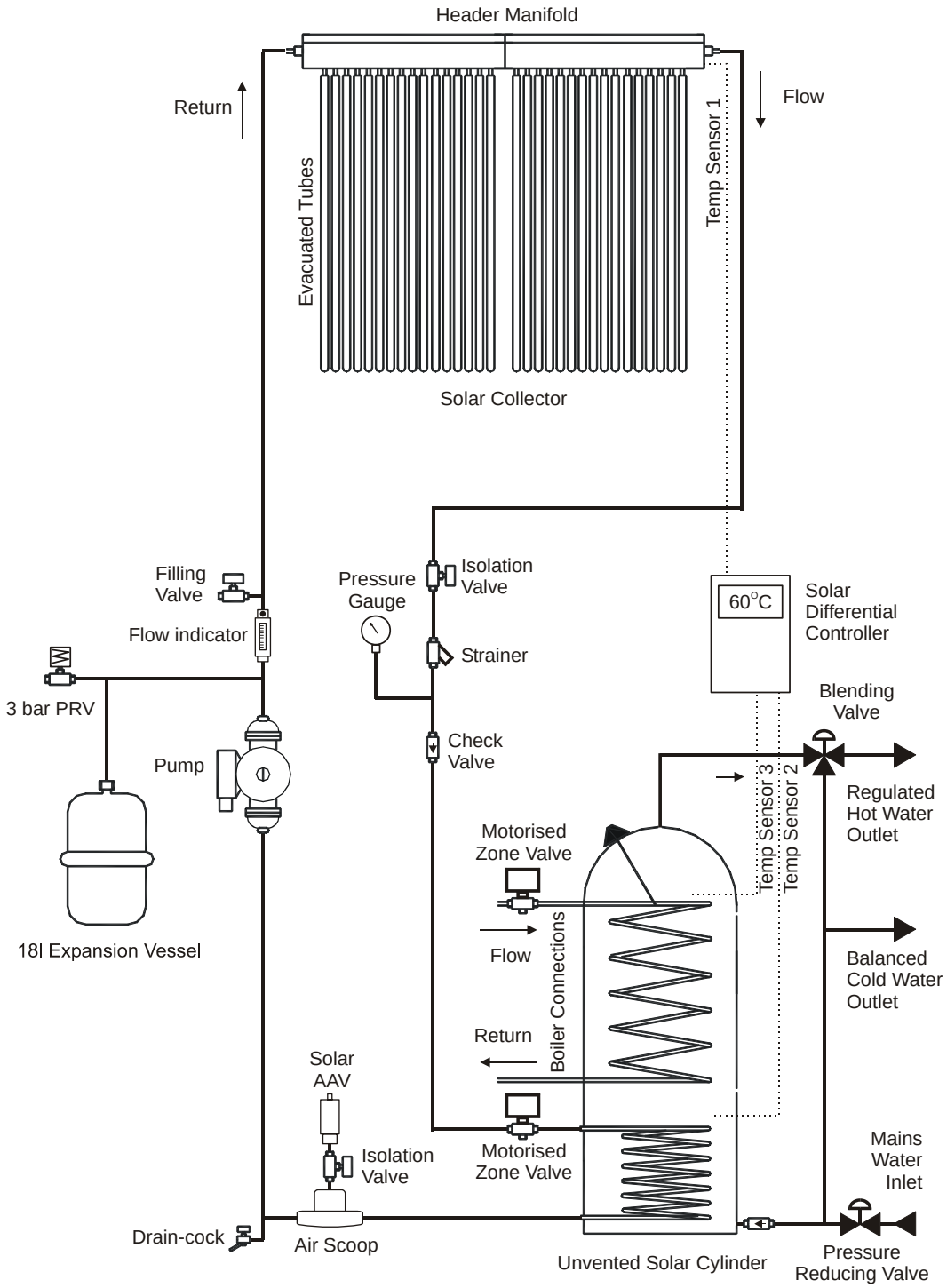
The evacuated tube collector (solar panel) efficiently converts sunlight to heat. As the temperature in the collector manifold rises the controller turns on the circulation pump and transfers the heat to a coil low in the hot water cylinder thereby raising the temperature of the water. A conventional heating system is still required to raise the temperature of the solar heated water (as necessary) to achieve the desired hot water temperature.

Solar Energy

The sun is a variable power supply, depending on time of day, cloud cover and season. Bright long sunny days in summer will provide the highest performance. On overcast or cloudy days there will be less energy reaching the solar collector and therefore less heating effect and lower temperatures.

System Diagram

Solar System
Sealed, pressurised, indirect unvented system



System Components

The solar heating system consists of many separate components that play a vital part in ensuring that the system operates to maximum efficiency under all conditions. The system should optimise the collection and transfer of solar energy, whilst minimising any losses.

The function of the major components is explained below. These components are shown in Solar Circuit Schematic diagram opposite.

- **Solar Collector**

The solar collector contains an array of 20 evacuated glass tubes (similar in construction to a Thermos flask). The outer side of the inner glass tube acts as the absorber surface and is covered with a 'selective' coating. This surface is within the evacuated space between the inner and outer tube wall and is protected from environmental degradation. The vacuum ensures that there is almost no heat loss to the atmosphere on a cold day.
Direct and diffuse solar radiation passes through the vacuum and is absorbed by the 'selective' coating on the tube surface and converted into heat. This heat is transferred to an internal heat-pipe by convection. The sealed copper heat-pipe transfers the heat via convection of its internal heat transfer fluid to a 'hot bulb' that indirectly heats a copper manifold within the header.

- **Cylinder**

The twin-coil solar cylinder has a total volume that should match the heat output from the collectors during the course of a summer day. Ideally, this volume should represent the total hot water required in one day. A secondary heat source (typically a boiler) is used to provide top-up heating if required. The boiler can only heat the upper 90-100 litres in the cylinder. Heating just the upper part of the cylinder allows the solar energy to be applied at the bottom (coolest) part of the cylinder to maximise the collector efficiency.

- **Controller**

The temperature controller constantly monitors the temperature difference between the solar collector manifold and the solar cylinder. This information is obtained from two temperature sensors: Sensor 1 located inside the collector manifold and Sensor 2 located in the bottom of the hot water cylinder. Sensor 3 is located in upper part of the cylinder and is used to monitor the hot water supply temperature.

It is recommended that the controller is left switched-on at all times

- **Automatic Air Vent**

The automatic air vent valve releases any air trapped within the system without releasing fluid. Most of the air will be manually vented during installation by manual operation of the Pressure Relief and Automatic Air Vent valves.
When the system is first filled with mains water it will contain dissolved air. This air will come out of solution and form bubbles when heated. Over the first few days of operation, or after draining and refilling the system, this valve will discharge air automatically.

- **Pressure Relief Valve**

The pressure relief valve is the primary safety component. In the event of high-pressure build-up (e.g. during a power cut, the valve can automatically discharge fluid to maintain a safe system pressure. It is a statutory requirement on all un-vented systems. Due to the system design the pressure rarely exceeds 3 bar even during a power cut.

The pressure relief valve can also act as a manual air vent and can be used when filling the system. It is opened by twisting the cap and will spring back to the closed position when released.

- **Filling Valve**

The filling valve is used to initially fill the system or top-up if the system pressure falls below 1bar.

- **Flow Meter**

The flow meter indicates the fluid flow rate through the solar circuit in litres per minute. A flow rate of 2-3 litres per minute is recommended. The flow meter contains a small quarter turn ball valve, used to regulate the fluid flow.

- **Pressure Gauge**

The pressure gauge indicates the pressure within the solar heating system. This slightly fluctuates depending on the temperature of the heat transfer fluid. A pressure between 1 and 2 bar is normal (indicated by the black needle). The red pointer indicates the minimum operating pressure that should be maintained in the system. This is normally set at 1 bar.

- **Expansion Vessel**

The volume of the heat transfer liquid in the system will expand and contract with changes in fluid temperature. A bladder within the expansion vessel maintains a constant system pressure by compressing a fixed volume of air contained within the vessel.

- **Circulating Pump**

When activated by the controller the pump circulates the heat transfer fluid around the system. The lowest pump setting (No 1) will normally achieve the optimum rate of circulation for efficient heat transfer.

- **Non-Return Valve**

This valve prevents reverse circulation in the solar circuit when the controller has switched off the pump. Reverse circulation would cause heat from the cylinder to be transferred to the collector and lost.

- **Strainer**

The strainer captures debris or any large particulates circulating within the solar circuit to reduce the possibility of damage to other system components.

- **Blending Valve**

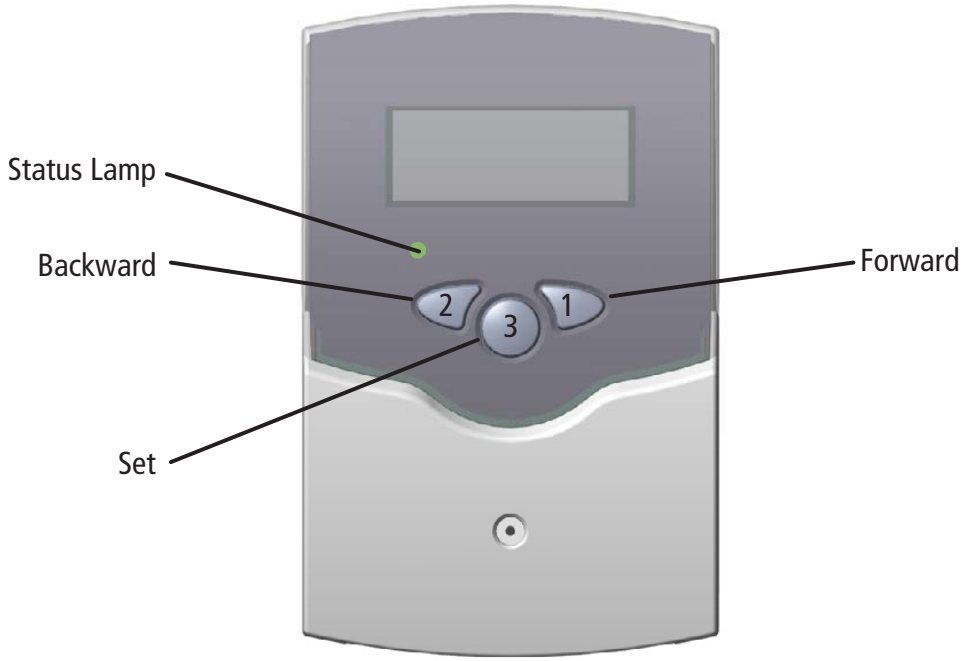
The blending valve ensures that the hot water reaching the taps is regulated to a pre-set temperature. The blend temperature is normally set at $50^{o}C – 55^{o}C$

- **Heat Transfer Fluid**

The heat transfer fluid contains corrosion inhibitor and anti-freeze. The anti-freeze should provide protection from extreme temperatures. Secondary frost protection is provided through the controller, which turns on the circulating pump if the collector manifold temperature falls to $4^{o}C$.

- **Controller**

The controller constantly monitors the solar system to ensure maximum efficiency and performance. Please refer to the Resol manual supplied with your system for detailed operating instructions.



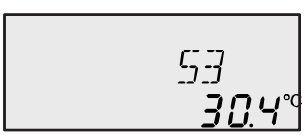
Resol Controller

The user may interrogate the controller using the panel buttons 1 & 2 to check system temperatures and hour counter. The hour counter totalises hours of solar gain since the unit was installed.

The system contains three temperature sensors:

COL = Temperature in the collector manifold on the roof (Collector)

TST = Temperature at the bottom of the cylinder (Temp Solar Store)



S3 = Temperature at the top of the cylinder

System Operation

The system operation is fully automatic and does not normally require user intervention, unless the led status indicator on the front of the controller is flashing red or the cylinder temperature reaches 95^{o}C.

- **Start-up conditions (pump on)**

The collector temperature must exceed 20^{o}C and if the temperature COL is 6^{o}C higher than temperature TST, the circulation pump will turn on and transfer heat to the lower coil in the solar cylinder. Heating will continue until either the temperature difference between COL and TST falls below 4^{o}C, or the temperature S3 reaches 85^{o}C.

- **Shut-down conditions (pump off)**

If the collector temperature COL falls below 20^{o}C.
If the difference in temperature between COL and TST falls below 4^{o}C.
If the temperature S3 reaches 85^{o}C.
If the sun continues to shine, the temperature COL will climb and the system will approach stagnation.

- **Stagnation conditions**

If the collector temperature COL reaches 120^{o}C the pump will turn on and further heat the cylinder until the temperature S3 reaches 95^{o}C.

If S3 reaches 95^{o}C the pump will be turned off under software control. A separate hard-wired temperature limit on the cylinder will also trip, requiring a manual reset by an engineer.

Once the system has tripped, the COL temperature will rise above the boiling point of the fluid in the solar circuit. The fluid will vaporise and push the contents into the expansion vessel. Once the temperature in the collector falls below 120^{o}C the fluid will condense and flow back into the circuit.

Note: *The only indication that this is happening is that the user will see the COL temp rising above 120^{o}C. If this occurs the temperature limit trip on the side of the cylinder must be manually reset.*

Making the Most of your Solar System

On days of high solar availability there will be a considerable volume of hot water by midday. Using hot water then will make the collector work more efficiently for the rest of the day giving you more hot water for the evening. Using the washing machine, dishwasher or doing the washing up after lunch would be convenient ways of matching hot water demand to solar output. Even on days of low solar radiation the efficiency of the collector will ensure a significant contribution to the water heating. Stored water is preheated easing the load on the boiler or immersion heater.

System Maintenance

- **Every Month**

Check the pressure gauge reading is between 1–2 bar. If the system pressure is below 1 bar the fluid circuit should be checked for leaks, then topped up.
The system can be topped using a garden pressure spray bottle fitted with a suitable adaptor. Only use Tyfocor LS fluid to top up the system – DO NOT TOP UP WITH WATER.

Check the flow indicator reads between 2–3 l/min. If the flow falls below this figure adjust the flow valve at the top of the flow indicator using a flat bladed screwdriver. If the flow is still insufficient increase the pump speed. If the flow is still insufficient, the strainer cap should be removed and element cleaned.

- **Every Year**

Check the operation of the pressure relief valve by rotating the cap until a little liquid is discharged. Release the cap to re-seat the valve.

- **Every Five Years***

Test the solar circuit fluid for PH level and antifreeze concentration, flush and refill if required
Remove and clean the strainer element.
Remove the flowmeter and clean the glass tube.

* Please contact Sussex Solar if you require instructions for this procedure, or if you would like us to perform this service for you.

- **Replacement of Tubes**

In the unlikely event of a tube being damaged it is possible to replace individual tubes without draining down the system. Please contact Sussex Solar if this situation occurs.

Troubleshooting

SYMPTOM	POSSIBLE CAUSE	ACTION
Controller screen is blank and the operation control lamp is off.	Controller power is switched off.	Turn the controller back on.
	Blown fuse in controller switch box.	Replace the 3 Amp fuse.
	Blown fuse in controller.	Switch off the controller Remove the cable cover (white). Replace fuse and cover. Switch the controller back on.
888.8 displayed instead of the temperature.	Loose connection on sensor leads.	Switch off the controller Remove the controller cable cover (white). Check sensor terminal screws are secure. Replace controller cover. Switch the controller back on.
	Faulty sensor.	Change sensor.
Flow gauge reads zero even when the pump symbol on the controller is flashing (on indication).	No fluid in the circuit.	Check the pressure gauge, if it reads less than 1 bar there is a leak or the pressure relief valve has opened. Slowly refill the system with water and inspect for leaks. If OK add antifreeze.
	Blockage in the circuit.	Isolate the check valve by closing the isolation valve.

		Carefully unscrew the strainer cap, then remove and flush the element to clear debris. Check and reset the temperature limit trip in the solar aqua stat
Pressure Gauge falls below 1 bar	Leak in the system or the pressure relief valve has opened.	Top-up the system and inspect for leaks.

Monitoring Your System

Once your system is commissioned, please continue to monitor its performance. This log will not only be helpful to you, it will help diagnose any problems.

Please record the figures towards late afternoon/early evening.

Day	COL Temp (°C)	TST Temp (°C)	S3 Temp (°C)	Time 00:00	HP Hrs	Pressure bar	Flow l/min	Weather Conditions		
										
1										
2										
3										
4										
5										
6										
7										
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10										
11										
12										
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17										
18										
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20										
21										

Month	COL Temp (°C)	TST Temp (°C)	S3 Temp (°C)	Time 00:00	HP Hrs	Pressure bar	Flow l/min	Weather Conditions		
										
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										

Continue to take readings at least once a month to ensure your system is operational and performance is maintained.

System Data

System description:	Evacuated Tube Heat-pipe Collector
System design:	Indirect flow sealed, pressurised system.
Instruments provided:	Digital Temp, Flow and Pressure gauges.
Heat Transfer Fluid in the system circuit:	Tyfocor LS
Method of accommodating 'No load'	Stagnation tolerant
Maximum temperature control:	Solar Controller, isolation valve and wired resetable trip
Method of frost control:	Anti-freeze plus controller minimum temperature function
Method of system control:	Microprocessor differential temperature controller.
Type of system:	Indirect, pressurised, twin coil cylinder

- **System Specification**

Collector's overall area:	2.25m^2
Collector's absorber area:	2.20m^2
Collector's overall net weight:	65kg
Daily average thermal efficiency:	55%
Flow rate:	2-3 litres/min
Volume of heat transfer fluid:	10 litres
Expansion vessel:	18 litres
Collector orientations:	South……
Solar panel ref:	SFB-20
Solar controller:	Model: Deltasol BS

Solar Cylinder

Type	Twin coil indirect, unvented solar cylinder
Size of cylinder:	450mm dia x 1200mm
Capacity:	168 litres
Make:	Newark Copper Cylinder Co
Insulation:	50mm thickness.
Immersion heater fitted:	3kW – element

Pipework

Solar (primary) system:	10,15mm copper plus 3/8” id S/St braided Teflon hose
Insulation:	Armaflex 10mm dia x 9mm wall
Pump:	Wilo Gold 15/50
Power for system control:	3 amp fused switch spur

- **Controller Settings**

The controller settings affect the its operation. The user should not normally change them.

If required, pressing the controller panel forward key down for more than 2 seconds will display the parameter values listed below.

FUNCTION	SETTING °C
Arr	1
DT0	6.0
DTF	4.0
SMX	85
EM	140
OCX	ON
CMX	120
OCN	ON
CMN	20
OCF	ON
CFR	4
OREC	OFF
OTC	OFF
OHQM	OFF
HND1	AUTO
HND2	AUTO
LANG	EN
PROG	68.30
VERS	1.00

Recommended Parameter Settings

Date of Commissioning: 16 March 2006…..……

Engineer's name: A Baxter.……

Warranty

The solar collector tubes are guaranteed against manufacturing defects for five years (excludes labour).

The solar system is guaranteed for 12 months from the date of commissioning, provided that all guidelines are adhered to and the customer does not change or modify any parts of the system or controller settings.

For service and support please contact:

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