KESTON BOILERS

SOLAR THERMAL SYSTEMS

User, Installation and Servicing Instructions

These instructions must be left with the user

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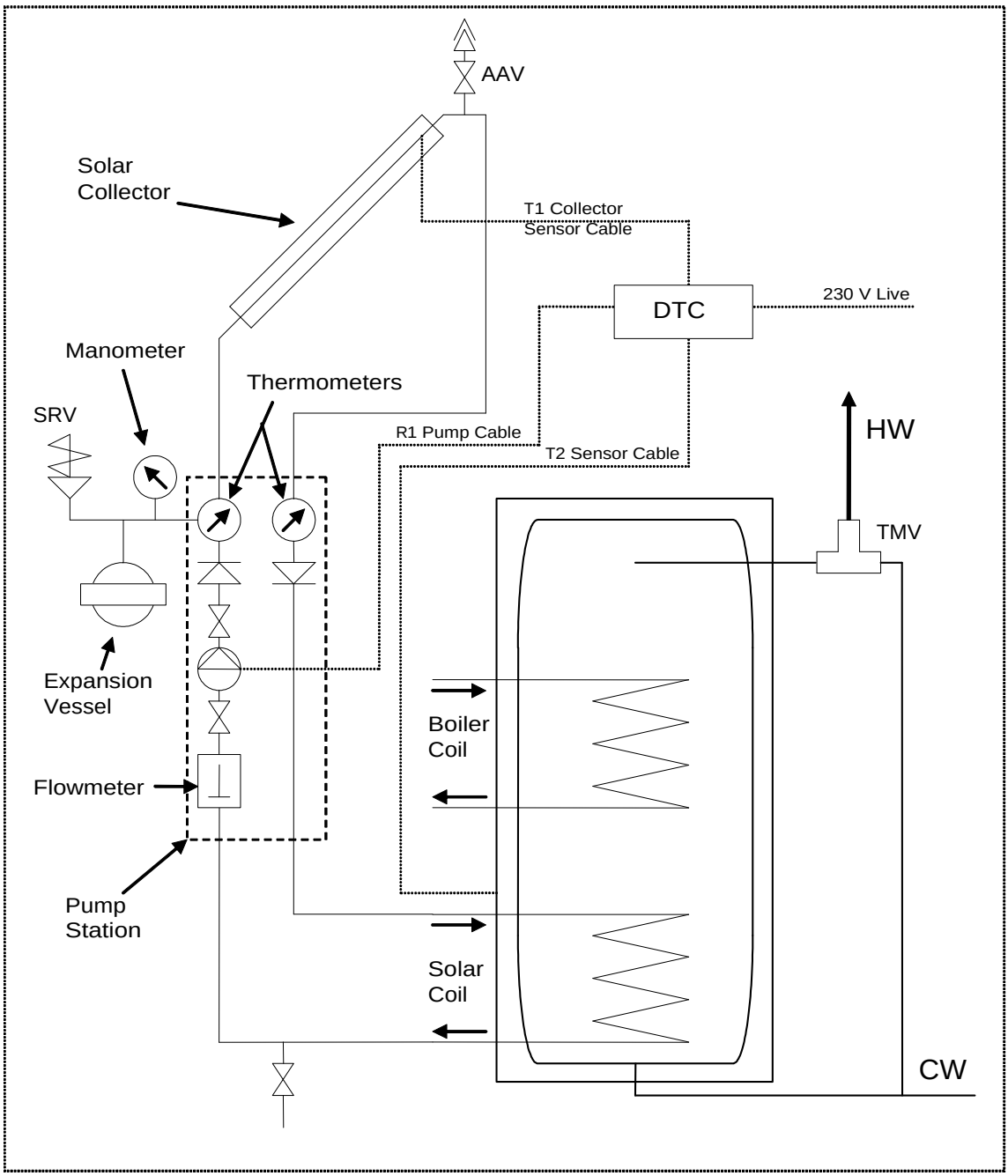
CONTENTS

1. General Instruction and Schematic Layout

The Keston Solar Thermal System is a “state-of-the-art” solar system. It features high performance collectors with highly advanced features. The collector has been awarded the Solar Keymark, the EU’s quality mark for solar collectors. The collectors are mounted on a fast-to-fit frame and, for the Solar Packs and Solar Duet, a solar pump station is also supplied to ease the internal component location. The Keston Solar Controller ensures efficient use of the available solar energy at any given time and features several extra functions such as modulating pump speed which further improve system efficiency

Keston Solar System Recommended Hydraulic and Control Circuit Layout



1.1 Performance Requirements

The Keston Solar System uses a similar hydraulic circuit to a standard system boiler. However, there are several important differences between these two circuits. A solar circuit has to manage both freezing and steam conditions in the solar collector.

The freezing is managed by using a suitable solar-grade glycol antifreeze within the circuit mixed to a suitable ratio for the climatic conditions.

The steam conditions can occur during “stagnation”. The Differential Temperature Controller (DTC) has an setting for the maximum temperature of stored (secondary) water in the cylinder (st. limit). During the summer months, when the building is unoccupied for several days, this store limit can be exceeded and the DTC will switch the solar primary pump off. With no flow through the collector, the collector temperature can exceed 200 °C on sunny days and steam will be generated in the collector. This steam can travel up to 2 m down both the flow and return pipes. In this condition, when the pump is eventually switched on again, the steam will travel down the flow line and typically condense when it reaches the hot water store. In this way the return line can contain water at up to 3 bar and 140 °C. The system has to be installed to manage these conditions.

1.2 Keston Solar Pack Contents

In your Solar Pack, Keston has provided you with the following:

- Solar-grade glycol antifreeze (which is designed to evaporate and condense)
- A solar pump station where all the components are designed to withstand these temperatures and pressures.
- Solar-grade Auto Air Vent (AAV) with manual isolator
- DTC with silicon high temperature collector sensor and intermediate temperature cylinder sensor
- A 2 or 3 collector system
- Pitched roof mounting kit OR
- Flat roof mounting frame (depending on pack type)

Before starting any work you should check that you have all the above items. A full break down of each parts list is provided in each relevant section of this manual.

1.3 Parts Not Included in the Solar Pack

You will have to provide all pipework, fittings and insulation. The following specifications are required for items provided by the installer:

Pipework. This should be 15 mm copper or flexible stainless on both flow and return. **Plastic pipework is not suitable for the temperature extremes possible in solar circuits**. Pipe clips must withstand the temperatures mentioned above. It is suggested to use gutter type external brackets over the insulation.

Fittings. Brass olive compression fittings must be used within 2 metres of the flow and return pipework from the collector. Lead free soldered fittings or brass olive compression fittings can be used on the rest of the solar primary circuit. Unleaded solder is not designed for solar circuits. Alternatively, high performance crimped fittings or similar performance

fittings can be used. Any drain valves etc. must be capable of handling the temperatures and pressures indicated above.

Insulation. This should be High Temperature "Armaflex" or similar grade insulation or above. Class O Armaflex is not UV-resistant or designed for the temperatures realised in the solar primary circuit. Polyethylene insulation will melt on a solar primary circuit. All external items such as cable clips to hold the collector sensor must be UV-resistant.

Flexible stainless steel hose is available in pre-insultated form using suitable high temperature UV-resistant insulation and a suitable two-core cable for the solar collector sensor. This hose is specifically designed for solar applications. Contact Keston Technical Support for further detail.

1.4 Collector Sizing and Location

Typically, approximately one square metre of solar collector should be supplied for each house occupant. Each Keston Solar Collector panel has an external area of 1.85 sq. m. Therefore, the Keston 2 collector array is ideal for a 3 to 4 person household and the Keston 3 collector array for a 5 to 6 person household. The collector array should be located anywhere between South-West and South-East at a pitch of 10° to 50°. Anywhere within this bandwidth will be within 10% of the ideal South facing 30° pitch. For an East-West roof, either an East-West application can be installed with a collector on each pitch or additional collector(s) can be fitted on either the East-West roof. For example, a 3 collector array on an East facing roof would be ideal for 4 to 5 occupants where there is a 20 % loss in performance as compared to the ideal South facing 30° pitch. There should be no significant overshading of buildings, trees or other obstructions. Even obstructions to the north of the collector can block a significant proportion of the diffuse solar radiation. Significant overshading can be compensated by over-sizing the solar system.

1.5 Planning Permission

Planning permission for the Keston Solar System is generally only required if you are in a conservation area or you are installing a solar system on a listed building. Solar water heating has permitted development status. Some local councils are objecting to this ruling and insisting that Solar requires planning permission but this is only the case if your building is listed or you are in a conservation area. If in doubt, contact your local council planning office.

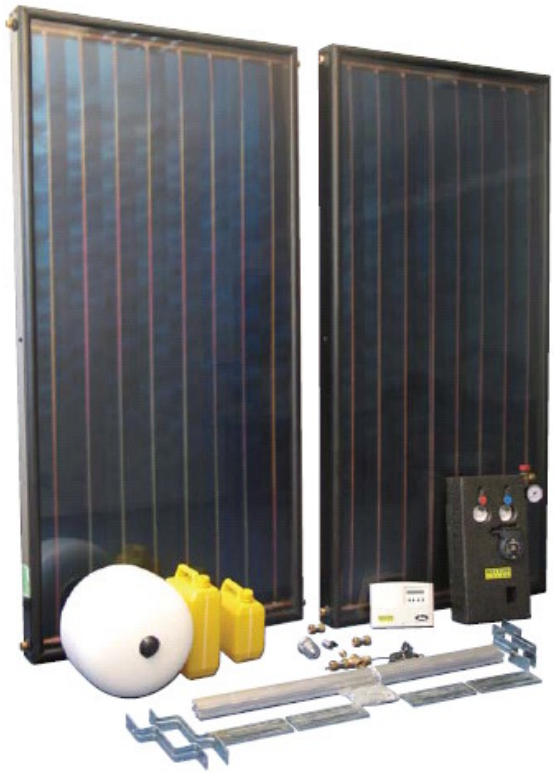
1.6 Warranty

As you would expect, the Keston Solar Thermal system is supplied with a comprehensive warranty cover of 5 years for the solar collector and 1 year for all other components. The warranties are provided on a parts only basis and are conditional upon provision of the relevant registration.

2.1 Installation of the Collector and external components

SOLAR COLLECTOR SPECIFICATION

Dimensions	1945 x 945 x 105mm
Weight	37.5kg
Liquid volume	2.36 litres
Flow Volume	100 lt/hr
Test pressure	20 bar
Max Working pressure	10 bar
Pressure loss	1.6 mbar
Absorber plate	Selective coating
Absorption level	95%
Thermal emission level	3%
Absorber plate	Copper sheet
Header/Absorber riser	24 / 12.7mm
Glass	Low ironed, Tempered Glass
Glass transmittance	91%
Insulation	CE certified High Density Rock wool
Weather proofing	EDPM /Silicon
Case	Painted Aluminium
Heat Endurance	232°C
Back Plate	Embossed aluminium case
Riser to absorber fixing	Ultrasonic
Number of risers	8

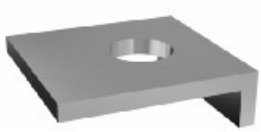


The Keston solar collector is made to an advanced specification. The collector is ultrasonic welded and made with a vacuum deposited titanium selective surface. For pitched roof installations, the collector comes with a roof mounting frame which consists of:

- 4 mounting plates (6 mounting plates for 3 collector systems)

- 2 roof “S”-brackets with top mounting bar and fixing nuts and bolts (3 roof “S”-brackets for 3 collector systems)

- 4 “L”-brackets for each collector



- 16 coach screws (24 coach screws for 3 collector systems)

- 2 Collector Inter-connectors (4 collector inter-connectors for 3 collector systems)

- Collector flow “cross” fitting with integral sensor pocket and top outlet (used for connection of the solar AAV and isolation valve, if roof mounted)

- Temperature sensor dry pocket

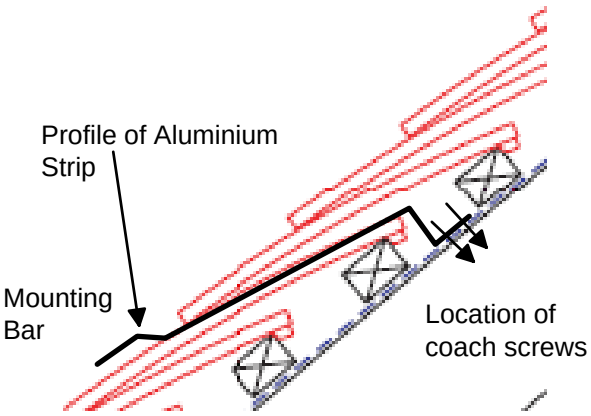
- 8 nuts, bolts and spring washers
- 4 aluminium strips (6 aluminium strips for 3 collector systems)

It is the installer’s responsibility to make sure the roof is water tight and secure. The Keston Solar Thermal System is designed for operation in standard UK geographic applications. For high wind exposure applications, it is the installer’s responsibility to make sure the collectors are suitably fixed to the roof. It is also the installer’s responsibility to maintain the necessary Health and Safety standards. Keston recommend the use of either scaffolding and/or custom made solar installation access equipment for the safe lifting and installation of the solar collectors. If in doubt, please use a competent roofer to install the collectors.

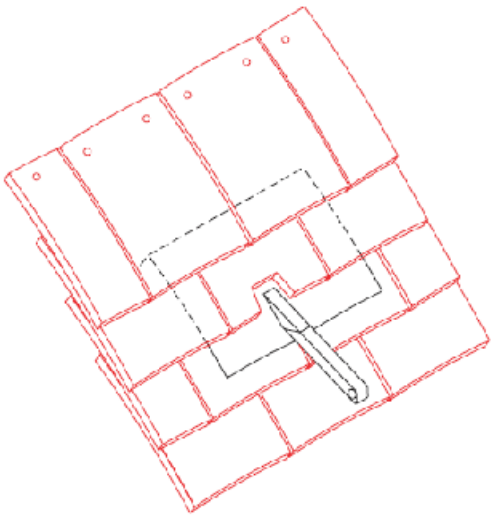
The National Federation of Roofing Contractors (NFRC) offers a solar panel roof mounting service via its network of approved members. The NFRC can be contacted on 020 7436 0387 or via www.nfrc.co.uk

The mounting plate and roof bracket are designed for use with concrete flat or profiled pantiles. For rosemary clay tiles or slate, the top and bottom mounting bar can be fixed with the 4 aluminium strips. Slates can be drilled with tile drills and rosemary tiles with a diamond drill. Any holes in the roof (which ideally should be completely avoided) should be sealed with an external grade low modulus silicon sealant or proprietary O rings. The aluminium strips can be bent to the shape of the tile to suit any profile. The aluminium strips must be coach screwed to either the rafters or noggins firmly located between the rafters. For rosemary tiles, Keston suggests using two coach screws to fix one end of the aluminium strip to the rafter and the feeding the strip out between two tiles and screwing the mounting bar to the exposed end of the strip.

Suggested side profile shape of aluminium strip for a rosemary tile roof



Another method for Rosemary tiles is to use the roof “S”-brackets as provided and then weathering the roof “S”-brackets into the roof with code 4 lead.



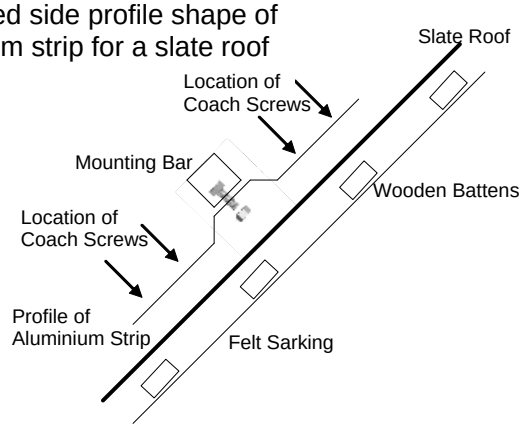
38) Safety hook fixings

Penetrations through the tiling such as pipes or safety hooks should be weatherered using a suitable metal flashing.

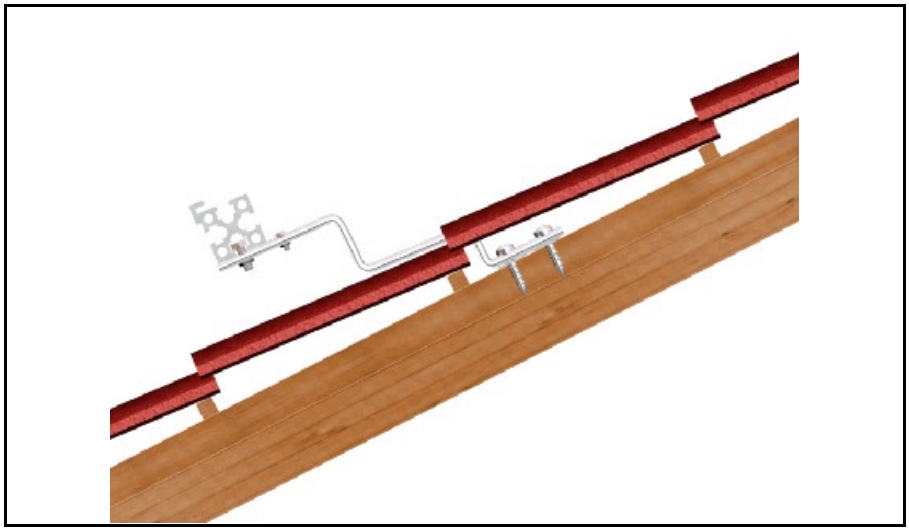
The flashing should be turned over the top of the tiles.

For slates, the tiles will need to be drilled. The internal rafters can be located by feeding an aluminium strip out from the loft between the felt sarking layers and then abutting the aluminium strip against the roofing rafter. The external exposed end of the aluminium will indicate the location of the internal rafter. Alternatively, use noggins between the rafters to firmly locate the aluminium strips.

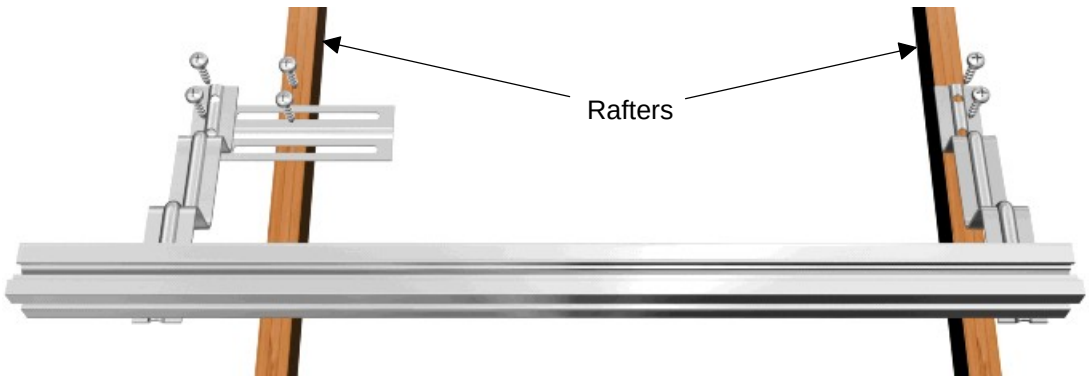
Suggested side profile shape of aluminium strip for a slate roof



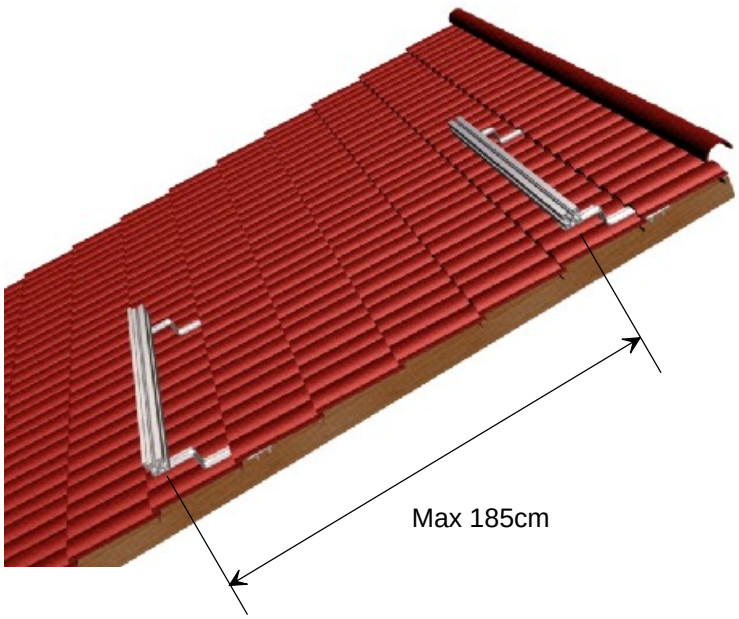
For flat or mildly profiled concrete pantiles, the roof hooks should be mounted as follows:



If the pantile is profiled, there might be a need to locate the roof hook to the joist using the mounting plate as a connector. Here is an example:



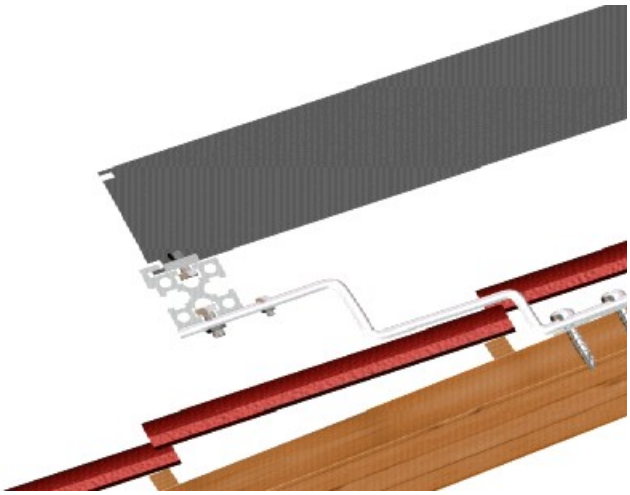
This example is based on a roof with a timber sarking. If no timber sarking is available, the nuts, bolts and spring washers as provided can be used to bolt the roof hook to the mounting plate. Another alternative is to place a noggin between the rafters to strengthen the mounting structure and screw the roof hook to the noggin.



Once the 4 roof “S”-brackets (or 6 roof “S”-brackets for 3 collectors) are firmly located and in position, the tiles which were

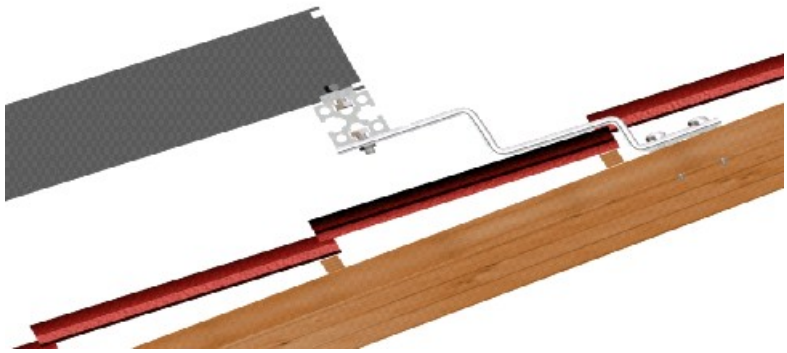
removed to locate the hooks can be replaced. The top and bottom mounting bars can then be bolted to the roof hooks.

The first collector slides into the bottom bracket and is located on either side by the L-brackets:

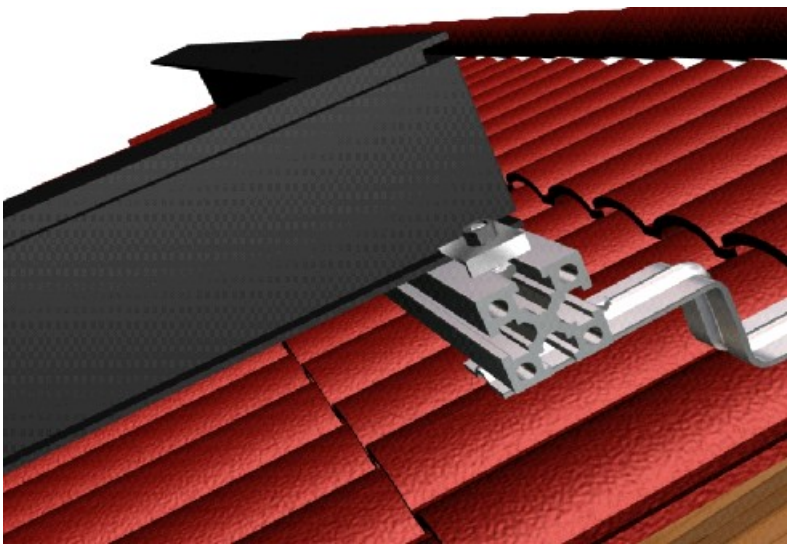


Bottom Fixing of the Collector:

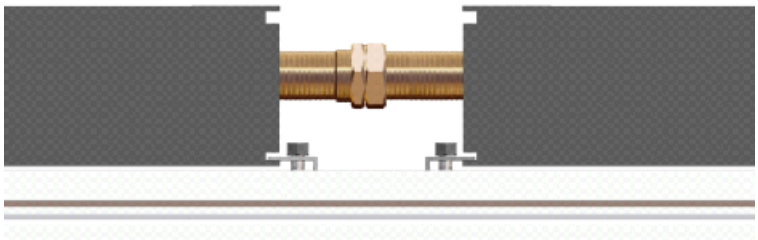
Top Fixing of the Collector:



Three dimensional diagram of final location of top of the collector:

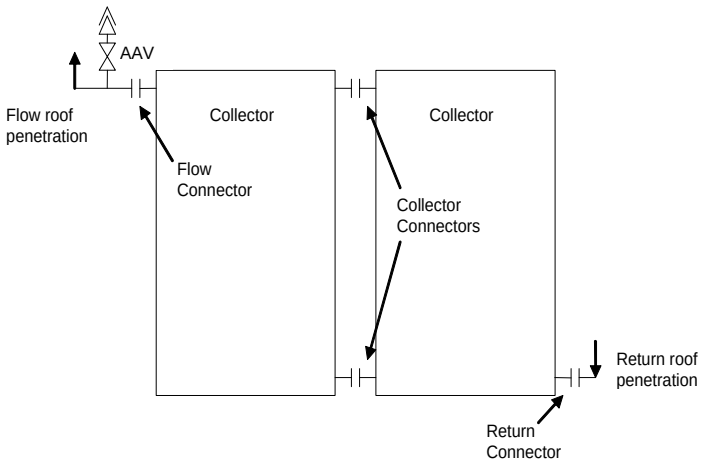


The second collector is then joined to the first collector using the supplied Collector Connectors:



The flow and return pipework can be passed through the roof either with a proprietary roof penetration tile or a Code 4 lead custom made roof penetration tiles. Ventilation tiles can sometimes be adapted for this purpose. Alternatively a silicon “dektite” can be used or Keston also supply as an optional extra a lead pipe flashing tile which can be adapted to suit most roof tiles. Any exposed elements of the roof penetration must be carefully sealed with exterior grade low modulus silicone.

Roof penetration using a lead pipe flashing tile



The collectors should be hydraulically piped as follows:

The AAV must be installed internally at a level above that of the panels (i.e. within the pitch of the roof) to allow access for manual venting from within the roof space. The final part of the roof installation is the insertion of the silicon PT1000 Collector Sensor into its mounting pocket in the Flow Connector and feeding of the cable through or under the flow roof penetration and through the felt or timber sarking so that the sensor cable is visible in the loft space.

2.2 Installation of the Pump Station and other internal components

The Keston Solar System features a flow and return line solar pump station and a solar grade expansion vessel. This expansion vessel is 24 litres because it needs to absorb the expansion of the steam in the collector during “stagnation”. All the components in the pump station are solar grade.

The pump station has 28 mm flow and return fittings. **These need to be reduced to 15 mm.** The pump is on the return line. The pump station contains a flowmeter, 2 check valves (to stop the heat thermosyphoning out of the cylinder during the night), a pump, a flow and return line thermometer, a manometer, two drain/fill valves, an SRV and a connection point for the expansion vessel.

Mount the pump station on a suitable wall and connect:

- top of the return line to the bottom of the collectors
- top of the flow line to the top of the collectors
- bottom of the return line to the bottom connection on the solar coil of the cylinder
- bottom of the flow line to the top connection of the solar coil of the cylinder
- a suitable drain valve in the return line
- the manually isolated AAV in the flow line either internally or externally as close as possible to the collectors

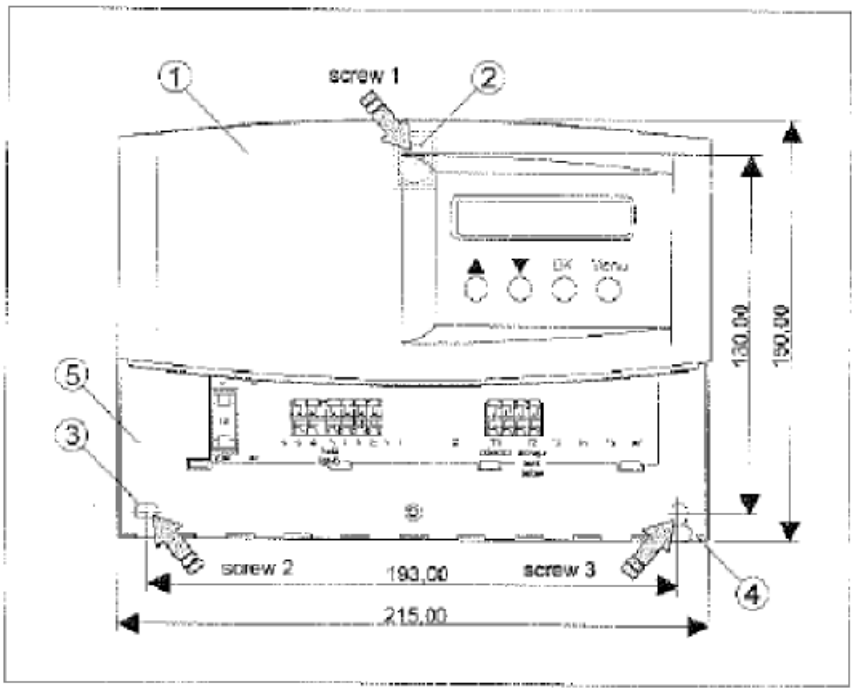
This can be seen in the Hydraulic and Control Circuit Layout in chapter 1. Externally terminate the Safety Relief Valve (SRV) where the exhaust can not scald anyone. If necessary, this SRV can be removed and blanked off from the pump station and fitted in the return line loft space to assist the external termination of the exhaust. The pipework from this valve to the external location must be in copper, stainless or other suitable pipe and it is the installer’s responsibility to take into account the steam or extremely hot water that might exhaust from this SRV.

The expansion vessel should be fitted vertically at the end of at least 1m of 22 mm pipework. This pipe length is to provide a water “buffer” to protect the vessel from extreme temperatures generated during stagnation conditions. If 1m of pipe cannot be accommodated a small buffer vessel may be considered. The expansion vessel must be mounted with the water side of the diaphragm above the air side.

2.3 Electrical installation and Solar Unvented Cylinders

The Keston Solar System is supplied with a Differential Temperature Controller (DTC) and 2 silicone high temperature PT1000 temperature sensors. The Keston DTC has several functions which improve performance and efficiency and also record historical data which is useful for diagnostic analysis of the system performance. All electrical installation must take into account part P of the wiring regs and pipes, pump, cylinder etc. must be bonded in accordance to BS 7671.

Power for the DTC can be taken from either the 10 way central wiring centre if used (the solar controller is part of the heating control circuit and so this is the ideal location) or alternatively from a 230 V 3A fused spur.



The DTC is designed for use with solar thermal water heating systems only

The Keston DTC is permanently on and functions by measuring the temperature in the collector (T1) and the temperature in the solar section of a twin coil cylinder (T2). When the difference between collector and cylinder temperatures (T1 – T2) reaches 8 degrees (adjustable), the DTC switches the solar pump (R1) on. When the difference between collector and cylinder temperatures (T1 – T2), reaches 4 degrees (adjustable), the DTC switches the solar pump (R1) off again.

The Keston DTC also has modulating speed control of the pump, storage temperature limitation and full monitoring of the hours of operation and maximum and minimum temperatures at T1 and T2. It is strongly recommended that the collector temperature limit, solid fuel/flue tank regulation and antifreeze functions are left switched off.

Installation

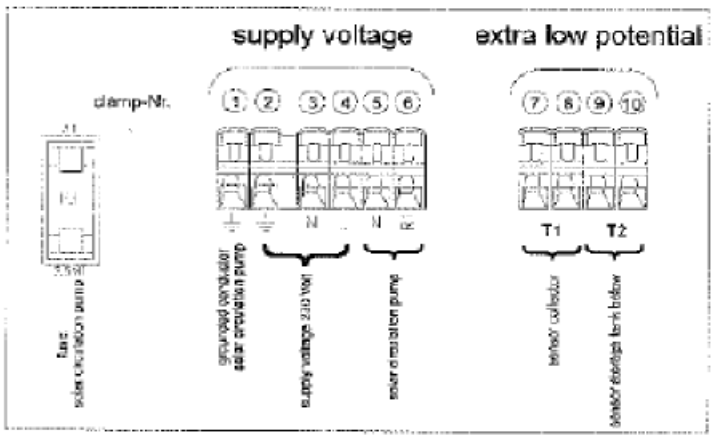
Choose a suitable location where the building occupants can easily access the control buttons and display of the DTC and fix screw 1 to the wall. Hang the controller onto this screw and use the DTC as a template to position screws 2 and 3.

Electrical Socket connections on the DTC

Electrical Connections. To avoid potential interference, the low voltage cables connecting sensors T1 and T2 to the DTC should be run at least 10 cm distant from any power cables.

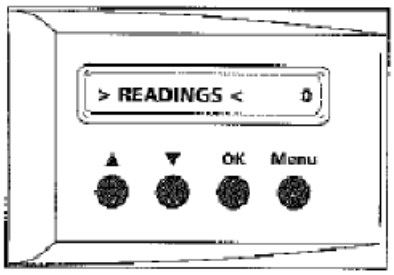
Sensor T1 should be located in the flow panel connector and terminated in the loft.

Both sensors T1 and T2 have no polarity. If the cable length between the DTC and T1 is less than 75m connect T1 to the DTC with 0.75 mm^2 dia two core cable. If the cable length between T1 and the DTC is between 75 and 150 metres, use 1.5 mm^2 dia two core cable. The cable length between T1 and the DTC must be no more than 150m.



Position the ends of the T1 cable in sockets 7 and 8 on the DTC. Connect sensor T2 in sockets 9 and 10 and the sensor end in the solar section sensor pocket location in the twin coil cylinder. This should be either close above or in the middle of the solar coil. If sensor T2 needs extending, please follow the same cable diameters requirements as for T1.

Connect the 230 V 3A fused live to socket 4, the associated neutral to socket 3 and earth to socket 1 or 2. Using appropriate heat resistant flex, wire the solar pump in the pump station to socket 6 for live, socket 5 for neutral and either sockets 1 or 2 for earth. Replace the electrical connection cover.



The above diagram shows the four control buttons and LCD display on the DTC. The DTC has 2 main menu options, **"READINGS"** and **"ADJUSTMENTS"**.

When in **"READINGS"**, after pressing the OK button, you can scroll up and down through the readings using the up and down scroll buttons. At any time whilst scrolling through the readings, you can return to the main menu by pressing the Menu button. The available readings are:

stor. Tank:	**°C**	T2 - temperature in solar section of cylinder
Collector:	**°C**	T1 - collector temperature
col. Max:	**°C**	Maximum collector temperature recorded
col. Min:	**°C**	Minimum collector temperature recorded
st. tank max:	**°C**	Maximum cylinder temperature recorded
st. tank min:	**°C**	Minimum cylinder temperature recorded
d-R1 hrs:	**hours**	Hours of solar pump operation since last reset
x-R1 hrs:	**hours**	Total hours of solar pump operation since installation of DTC

All the maximum, minimum and hours readings (except for total pump hours) can be reset by holding the OK button down for 2 seconds when this reading is visible in the display. These maximum, minimum and hours readings can be used for diagnostic analysis of the performance of the solar system.

Whilst in the main menu, you can scroll between **"READINGS"** and **"ADJUSTMENTS"** using the scroll buttons. Whilst in **"ADJUSTMENTS",** you can enter the submenus **"PARAMETERS", "FUNCTIONS"** and **"MAN. OPERATION"** by pressing the buttons OK + Menu at the same time. You can scroll through these 3 submenus using the up and down scroll buttons.

Whilst in any of the 3 submenus, you can enter the settings by pressing the OK button. Then, whilst below the submenus, the scroll buttons move you between the various settings.

PARAMETERS contains the following three settings (with the recommended values):

st. Limit:	**60 °C**	Maximum store temperature at sensor T2
ON-TDiff:	**8 deg**	T1-T2 to bring pump on - default setting 8 deg
OFF-TDiff:	**4 deg**	T1-T2 to turn pump off - default setting 4 deg

The **st. limit: 60 °C** should be left at 60 °C unless the solar system is installed in a soft water or conditioned water area when the temperature can be reset up to 80 °C. Consideration of point of use scalding should be considered when altering the store limit temperature. **The use of Thermostatic Mixing Valves (TMV) is important for raised store temperatures.**

ON-TDiff: 8 K should be left on 8 and **OFF-TDiff: 4 K** should be left on 4 unless there is a long pipe run when the two values can be increased in proportion to the temperature drop on the flow line between the collector and store.

FUNCTIONS contains the following settings (with the recommended values):

Tmin a. Fuel:	**OFF**	(ON makes the DTC a solid fuel controller)
col. Limit:	**OFF**	(collector cooling function not required by Keston solar)
Antifreeze:	**OFF**	(runs system without antifreeze. For hot climates)
speed contr:	**ON**	(modulating pump speed control. See commissioning)
T1: KTY	**OFF**	(using system with alternative sensor types)

MAN. OPERATION contains the following settings (with the recommended values):

pump P1:	**OFF**	(manual control of the solar pump)
preset config.		(returns controller to factory preset conditions)

To change any of the settings whilst in the submenus, the OK button should be held down for 2 seconds.

All the functions should be left as factory preset. The speed control function will be further discussed in the commissioning section. The manual control of the pump is useful during commissioning of the solar system.

Resistance values of the temperature sensors

KTY81-210

temperature [°C]	0	10	20	30	40	50	60	70	80	90	100	110	120
resistance [Ω]	1630	1772	1922	2080	2245	2417	2597	2785	2980	3182	3392	3607	3817

PT1000

temperature [°C]	0	10	20	30	40	50	60	70	80	90	100	110	120
resistance [Ω]	1000	1039	1078	1117	1155	1194	1232	1271	1309	1347	1385	1423	1461

Technical data

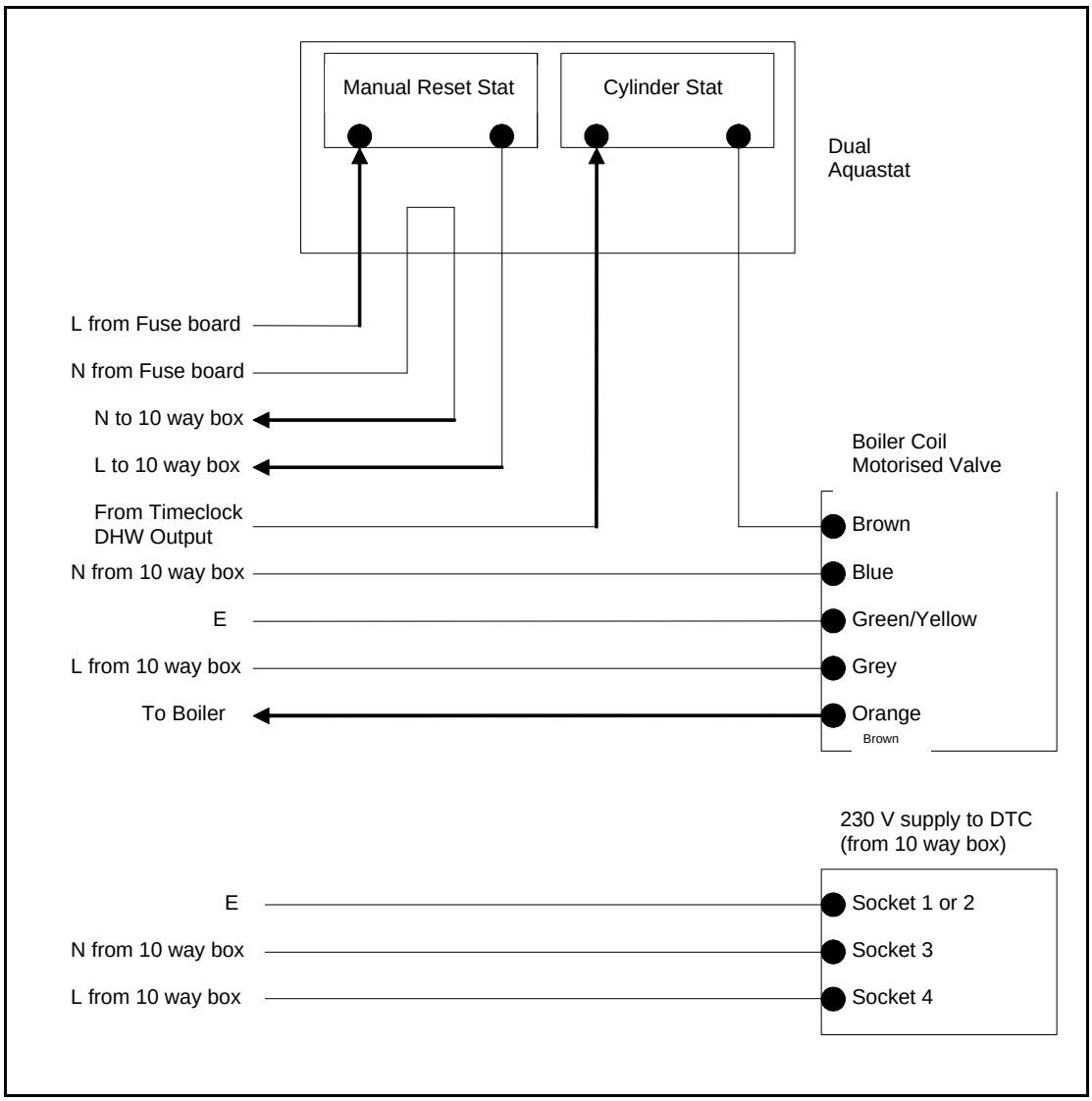
• Nominal voltage	,230 Volt (± 15 %), 50 Hz [optional 115 Volt (±15 %), 60 Hz]
• Max. self consumption	≤ 1,0 W
• 2 inputs	
2 x temperature determination	PT1000 or KTY81-210
• 1 output	
R1	Triac for speed control, max. switching capacity 200 W at 230 V [or 100 W / 115 V]
• All outputs are protected against overload and short circuit	
• Adjustment ranges	
Turn-on temperature difference	4...17 K
Turn-off temperature difference	2...15 K
• Display	16-char LCD display, menu-driven clear text display
• Permissible ambient temperature	0° C...+45° C
• Installation	wall installation
• Weight	460 g
• Casing	Recycleable 3-part plastic casing
• Dimensions l x w x h (mm)	150 x 215 x 43 mm
Temperature sensors	
• storage tank (*): PT1000	1,5 m silicon cable (colour black), measuring range up to 180° C
• collector (**): PT1000	1,5 m silicon cable (colour black), measuring range up to 180° C

Unvented cylinders and the Keston Solar System

The second level of control on an unvented “G3” cylinder requires that there should be an isolating valve within one metre on the flow line of the boiler coil to cylinder connection. This isolating valve is wired to a manual reset thermostat. This boiler system solution is not feasible for a solar system as, due to the raised temperatures and pressures, even solar grade valves installed on the flow line can fail.

Therefore, ideally the power to the 10 way central heating control box is wired through a single manual reset thermostat located in the top of the unvented cylinder. This will cut power to both the boiler and solar circuits.

Proposed Manual Reset and Cylinder Thermostat Electrical Wiring Diagram



Alternatively, two manual reset thermostats can be employed on the heating system. One thermostat, located to respond to the boiler coil, is wired conventionally as per manufacturer’s instructions to the boiler heating controls and the solar manual reset thermostat,

located to respond to the solar coil, is wired to isolate power to either the DTC or the solar pump.

Please also note that if the panel is located below the cylinder, there is potential for the heat to thermosyphon from the collector to the cylinder and in this case, the only solution is to fit a solar grade isolating valve within one metre of the solar return line to cylinder connection and this valve must close as soon as the manual reset thermostat is opened.

Part L Building Regulations

The installer has a requirement under Part L to confirm installation or install a cylinder thermostat and zone valve to control the boiler section of the cylinder hot water temperature and to provide a boiler interlock. The cylinder insulation must also be brought up to Part L standards.

3. Commissioning of the Solar System

An important safety consideration on filling the solar system is to prevent the fluid boiling on entry into the collector. If there is any chance that the collector will exceed 100 °C during the commissioning procedure, the collector must be covered.

By turning both of the thermometers on the pump station an eighth of a turn clockwise, the check valves are disconnected from the solar primary circuit and fluid can flow in either direction. By turning both the thermometers a quarter turn clockwise, the check valves are fully closed.

1) Open the circuit by disconnecting both check valves (thermometers an eigth turn clockwise).
2) Fill the solar primary circuit and flush the circuit of all the installation debris.
3) Mix the Keston supplied antifreeze with water at a ratio of 1 part antifreeze to 3 parts water (25% concentration). In climates where –20 °C can be realised, increase this concentration ratio to 40%. *We suggest that due to the low volume in the solar primary circuit, that the solar system is filled from a dosing station as supplied by the water treatment specialists. Keston strongly recommend that a filling loop is not fitted on the solar primary circuit as this can lead to dilution of the antifreeze.*
4) Check the expansion vessel has a pre-commissioning pressure of 1 bar.
5) Connect the dosing vessel to the lower filling valve, make sure that the check valves are in the open position and that the manual isolator on the AAV is open.
6) Fill the circuit from the dosing vessel and pressurise the circuit to 1.5 bar.
7) Manually switch the DTC to on and check pump is running.
8) Purge the remaining air from the circuit and isolate the AAV.
9) Activate the check valves by turning the thermometers an eighth of a turn anticlock-wise.
10) Whilst the DTC is on manual, set the pump on setting 1 and adjust the flowmeter so that the flowrate is between 1 and 1.5 litres/minute/m^2 collector i.e. between 4.2 & 6.3 litres/min for 2 collectors and 6.3 & 9.45 litres/min for 3 collectors. *The flowrate can be viewed as the bottom line on the flowmeter. If necessary, increase the pump speed settings. Ideally, the pump is set on speed 1 and the flowmeter adjustment screw is in the vertical position.*
11) After purging the air, manually switch the DTC to off and using a refractometer or a hydrometer, recheck the concentration of the fluid in the circuit. Adjust to correct ratio.
12) Reset the DTC to Auto. *The Pump Speed Control (PSC) function will automatically adjust the flowrate to suit the differential temperature. PSC is employed to improve system efficiency by improving the heat recovery from the solar collectors and reducing pumping electrical losses. Alternatively, if the PRC function is switched off, make sure the flowrate is set to 1 litre/min/m^2 collector.*
13) The DTC thermostatic cylinder limit temperature (**st. limit**) has a default of 60 °C. Leave it on this setting unless soft water is available in the property. If soft water is available, the thermostatic cylinder limit can be reset up to 80 °C.
14) Always, even at 60 °C, thermostatic mixing of the water should be considered. Water can scald from 47 °C. Any TMVs fitted close to the cylinder with long pipe runs to the points-of-use should set the temperature above 55 °C and below 60 °C.

Commissioning Certificate

It is highly recommended that a form of commissioning certificate is left with the householder for safekeeping. The certificate should contact the following information:

Expansion vessel pre-charge pressure	bar
Solar primary circuit pressure	bar
delta T_{on}	K
delta T_{off}	K
st. Limit	°C
TMV fitted	Yes/No
If yes, point-of-use temperature	°C
PSC control	Yes/No
If no, flowrate set to:	litres/min
Antifreeze concentration	%
Antifreeze supplier	Keston / Other ……

4. Handing over to the user

There is no day-to-day control required of the Keston Solar System. The system is completely self-sufficient and requires no maintenance on the part of the building occupants. However, most customers like to be informed about the solar system and how to maximise the performance of the solar system so that they use as little fossil fuel for hot water heating as possible.

Therefore, the customer should be shown:

- On the DTC, the “READINGS” menu and how to scroll through the readings. Some explanation of maximum and minimum readings and hours of operation is recommended.
- So that the user can check system operation during solar radiation, the functioning of the flowmeter and the “on” symbol on the LCD display of the DTC
- If an unvented cylinder is fitted (such as the Keston Spa), the manual reset thermostat and action to take if this thermostat needs to be reset i.e. a solar competent heating engineer should be called out to check the source of the fault.
- The exhaust point of the SRV and what action to take if steam or water is seen coming from the end of this pipe i.e. a solar competent heating engineer should be called out to check the source of the fault
- How to manage the boiler cylinder thermostat and timeclock so as to maximise the solar gain. Please see below.
- The installation manual and commissioning certificate, both of which should be left on-site

Maximising the output from the Keston Solar System

If the solar system has been connected to a twin-coil cylinder, both the boiler heating circuit and solar heating circuit can heat this cylinder. The lower section of the cylinder is available for the solar circuit. The upper section of the cylinder is available to the boiler circuit.

The solar heating circuit operates most effectively when it has the largest volume of water to heat. Therefore, especially during the summer months, Keston strongly recommends that the boiler control circuit is left off during the “solar” day (when the sun is likely to heat the cylinder) so as to provide the solar circuit with as much work as possible. This will minimise the fossil fuel heating bill. The cylinder is well insulated and so will retain its heat for a long time unless the water is run off at the points-of-use.

The building occupant’s lifestyle will determine the optimum settings for the boiler controls. The aim is to leave a reasonable volume of water in the boiler section of the cylinder at a temperature which is warm enough to still provide an adequate temperature at the points-of-use and cool enough to obtain as much of the available solar energy as possible. Many occupants find that they can often run on solar only during the summer months. However, the occupants should be warned about the legionella risk of running on a solar only setting i.e. the boiler section of the cylinder should reach at least 55 °C everyday and preferably 60 °C everyday.

If the customer's find that they have enough water available for washing etc. during the morning and early afternoon period, one ideal setting is to switch the boiler section of the cylinder on everyday for an hour between 8 and 9 pm. This setting will make sure the cylinder passes through the 55 to 60 °C once a day and also provide the solar circuit with the maximum workload during the solar day.

Ultimately the customer should find their own optimum boiler timings for DHW according to their needs. The less the boiler is fired for DHW, the better.

5. Routine Servicing

MAINTENANCE SCHEDULE TO BS 5918: 1989 -
Code of practice for SOLAR HEATING SYSTEMS FOR DOMESTIC HOT WATER
British Standards Institution (Indirect)

While a properly designed and installed solar heating system should be expected to give a service life comparable to that of other types of heating systems, some maintenance may be necessary to maintain the efficiency of the installation.

During a maintenance inspection the following items should be checked:

1. That unions and glands are free from weeps
2. That the glazing seals are weathertight and sound
3. That the collector circuit is free from air
4. That all air eliminators, non-return valves, solenoid valves and motorised valves are operating correctly
5. That the correct volumes and system pressure are maintained (at rest and in operation)
6. That the electrical controls are operating correctly to the manufacturer's instructions
7. That circulating pump is operating without undue noise or vibration
8. That all insulation is firmly attached
9. That all covers are in place
10. That no condensation or damp spots are apparent, particularly around the pipes and fixings in the roof
11. That the roof fixings are firm and the roof covering is free from cracks
12. That the weathering is properly protecting the structure
13. That the collector glazing is clean
14. That the glazing is free from cracks
15. That there is no evidence of serious corrosion
16. That any paintwork is sound
17. That all sensing devices are firmly and properly in place
18. That the life of the heat transfer fluid has not expired

Keston recommend that the above maintenance procedure is followed annually, preferably when the boiler and/or cylinder is also serviced.

The antifreeze has a service life of 5 years and so this fluid must be changed at each 5 year interval.

Before decommissioning/draining the solar circuit, make sure there is no chance for collector temperature to exceed 100 °C, that all check and isolating valves are open and that the antifreeze mixture is captured in storage vessels for safe disposal at a recognised safe disposal centre.

6. Fault Finding

6.1 No flow solar primary circuit

POSSIBLE CAUSES	ACTION
System in “stagnation”	Check **st. limit** at max
Airlock in circuit	Purge air
Manometer on low pressure	Refill and manually operate DTC
Faulty check valve	Check open and if necessary, replace
Steam escaped from AAV	Manual isolate AAV and refill. Check expansion vessel
Fluid exhaust from SRV	Check expansion vessel, SRV & refill
Faulty or blocked pump	Free, clean and if necessary, replace
Frost damage to collector	Replace collector and recommission circuit
Blocked circuit	Check for degraded old antifreeze blockage or limescale blockage
PT1000 sensors loose	Relocate sensors
Faulty DTC	See below

6.2 Low performance of solar system

POSSIBLE CAUSES	ACTION
faulty DTC/system settings	Check delta T_{on} and delta T_{off} settings, flowrate and Pump Speed Control. Also check functions ON/OFF and DTC on Auto
Faulty PT1000 sensors	Check sensor location and check electrical resistance to temperature (see table in ch 4)
Faulty pump	Check pump is rotating. Check valves open and pump speed correctly set
Restriction in circuit	Check circuit components and for old antifreeze/limescale restriction in pipes
Inadequate air removal	Purge air
Loss insulation	Reattach insulation
Boiler primary circuit providing too much heat	Reset central heating timeclock to give solar system more cylinder water to heat

6.3 Water too hot at points-of-use

POSSIBLE CAUSES	ACTION
Incorrectly set DTC	Check **st. limit** on DTC
Incorrectly set TMV	Check output temperature from TMV
Faulty boiler primary circuit	Check out boiler primary circuit for faults

6.4 Faulty DTC

POSSIBLE CAUSES	ACTION
No LCD display	No power supply, check fuse and 230 V
LCD says **Short circuit T1/T2**	Check relevant sensor for short circuit
LCD says **Interruption T1/T2**	Check relevant sensor for circuit break

7. Parts List

Keston Boilers Solar Kits contain the following items:

Description	Part Number	Kit PA2	Kit PA3	Kit FA2	Kit FA3
Solar Collector Panel CLS1808	SP18101000	2	3	2	3
Onto roof mounting set	SP18102000	2	3	-	-
Flat Roof Stand	SP18103000	-	-	2	3
Collector Inter-connectors	SP18104000	1	2	1	2
Flow connector fitting	SP18100040	1	1	1	1
Panel Sensor Pocket	SP18305000	1	1	1	1
Automatic Air Vent	SP18105010	1	1	1	1
Isolating Valve	SP18106000	1	1	1	1
Solar Pump Station	SP18202000	1	1	1	1
Solar Controller (DTC)	SP18301000	1	1	1	1
Expansion Vessel - 18 litre	SP18402000	1	-	1	-
Expansion Vessel - 25 litre	SP18407000	-	1	-	1
Vessel Fixing Bracket	SP18407000	1	1	1	1
Vessel Connecting Hose	SP18408010	1	1	1	1
Glycol Antifreeze		8 litre	10 litre	8 litre	10 litre

The above kits are also available with Keston SpaTwin double coil unvented cylinders. A SpaTwin 200 (200 litre) is packaged with a 2 panel kit, a SpaTwin 300 (300 litre) is packaged with a 3 panel kit.

Keston supplied optional extras for roof penetration:
Keston can also supply kits for “in-roof” mounting of the panels. Contact Keston for more detail.

KESTON SOLAR THERMAL SYSTEMS

INSTALLATION KEY POINTS

AND

COMMISSIONING CHECKLIST

- ☐ Installation Manual has been carefully read and followed.
- ☐ The roof mounting of the collectors is secure from both wind damage and rain penetration.
- ☐ The fully-filled solar circuit has been installed to manage both freezing and "stagnation" conditions.
- ☐ Has the AAV been fully isolated after setting the pressure to 1.5 bar, purging of air and commissioning?
- ☐ Have both check valves (under temperature gauges) been left in the correct position?
- ☐ Does the SRV terminate to a safe location, have the pump valves been left open and has the flow rate been appropriately set with either PSC or 1 litre/min/m^2 collector?
- ☐ The solar-grade expansion vessel must also be on the return pipework and should be mounted vertically at the end of a 1m length of 22 mm pipework for each m^2 of collector. **Expansion vessel is supplied.** Has the expansion vessel been correctly installed with a pre-commissioning pressure of 1.0 bar?
- ☐ Drain/fill valves have been selected to deal with temperatures and pressures realised in that part of the circuit.
- ☐ Brass olive compression fittings have been used within 2 metres of the collector and lead-free solder fittings on the rest of the solar primary circuit and all the pipework is copper or stainless steel (or superior specification to the above).
- ☐ High-temperature "armaflex" or similar insulation has been used throughout the solar primary circuit.
- ☐ All external insulation, cable, cable clips etc are UV-resistant.
- ☐ Thermostatic Mixing Valve (TMV) or similar protection for the building occupants is provided.
- ☐ Diferrential Control (DTC) settings are as directed in the manual and suitable legionella protection implemented
- ☐ The differential controller has been correctly wired. That is an electrical supply of 230 V fused at 3A and the solar pump has been wired in heat resistant flex. Cables between the sensors and the differential controller are in 0.75 mm^2 cable for up to 75 m and 1.5 mm^2 for up to 150 m length and located away from 230V interference.
- ☐ For unvented cylinders, for the second level of control, either the pump or differential controller must be wired via a mechanical reset thermostat.
- ☐ On an unvented cylinder, if the collectors are vertically below the hot water store, a solar-grade 2 way valve must be located in the return pipework within 1 m of the store.
- ☐ The pipes, pump and cylinder are bonded to BS 7671.
- ☐ To confirm with Part L, the installation of a cylinder thermostat and zone valve to control the boiler section of the cylinder hot water temperature and a boiler interlock has been confirmed or provided. The cylinder has been suitably insulated.
- ☐ A Commissioning Certificate is completed and the Certificate and solar system has been fully handed over to the customer.