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Instructions for Installation and Use of LILI-ES Solar Hot Water System

prepared by

low-impact living initiative environmental systems ltd

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Instructions for Installation and Use of LILI-ES Solar Hot Water System

2 Explanation of System Design

The LILI-ES system forms a closed loop that circulates a special fluid through the collectors (panels) when the fluid is heated by the sun. The fluid then passes through a heat exchanger coil in a special twin coiled water cylinder where it gives up its heat to water.

The pump that circulates the fluid is controlled by an electronic controller that is operated by 2 temperature sensors. A sensor is mounted on the hottest pipe at the collectors and another is located adjacent to the heat exchanger. When the roof sensor is hotter than the cylinder sensor the controller switches the pump on. The pump will continue to run until a preset temperature is reached in the cylinder. This temperature is usually set to 60 degrees centigrade to prevent scalding and excessive lime scale build-up.

The fluid in the system is put under two Bar of pressure. This pressurisation increases the boiling point of the fluid to beyond the temperature that can be reached under normal operating conditions. A safety valve is set to three Bar to ensure that pipe-work is protected but due to the design of the system this safety valve is more of a legal requirement and we do not expect to see it ever operate.

Following much research and experience we offer a system that we refer to as ‘intrinsically secure’. This type of system is designed to operate without the need for skilled attention even under the most severe conditions, for example the power supply failing on the hottest summer day. This reliability can be achieved because all of the components used in the system are rated for the highest temperature that can be generated by the collectors (panels). Also, in the worst case scenario for a solar water heating system, which is that the fluid in the system boils, the fluid is retained in the system, so that on cooling, the system returns to normal operating mode. The fluid can be retained in the system on boiling because the expansion vessel used is large enough to absorb the fluid pushed out of the panels when it boils. On cooling, the expansion vessel pushes the fluid back into the panels as the vapour condenses. The system fluid is very temperature stable and remains unaffected over time.

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3 List of Components Supplied

The following components are supplied with the LILI-ES Solar Hot Water System:

- SUNLILI 2 solar collectors – number of collectors depend on occupancy and water use of dwelling.
- Twin coil solar hot water cylinder.
- Electronic controller with 3 sensors.
- Pump set with one-way valve, pressure release valve, flow meter and fill points.
- 18 litre expansion vessel.
- Expansion vessel wall bracket and connector.
- Automatic air vent with isolation valve.
- Sensor pocket for collector.
- Pressure bottle for filling the system.
- Roof mountings
- Ten litres of system fluid (Tyfocor LS).

3.1 Optional components that can be supplied by special order

- Armaflex High Temperature Insulation
- Delta Pro controller for more sophisticated system control and data logging.

3.2 Illustrated System Components

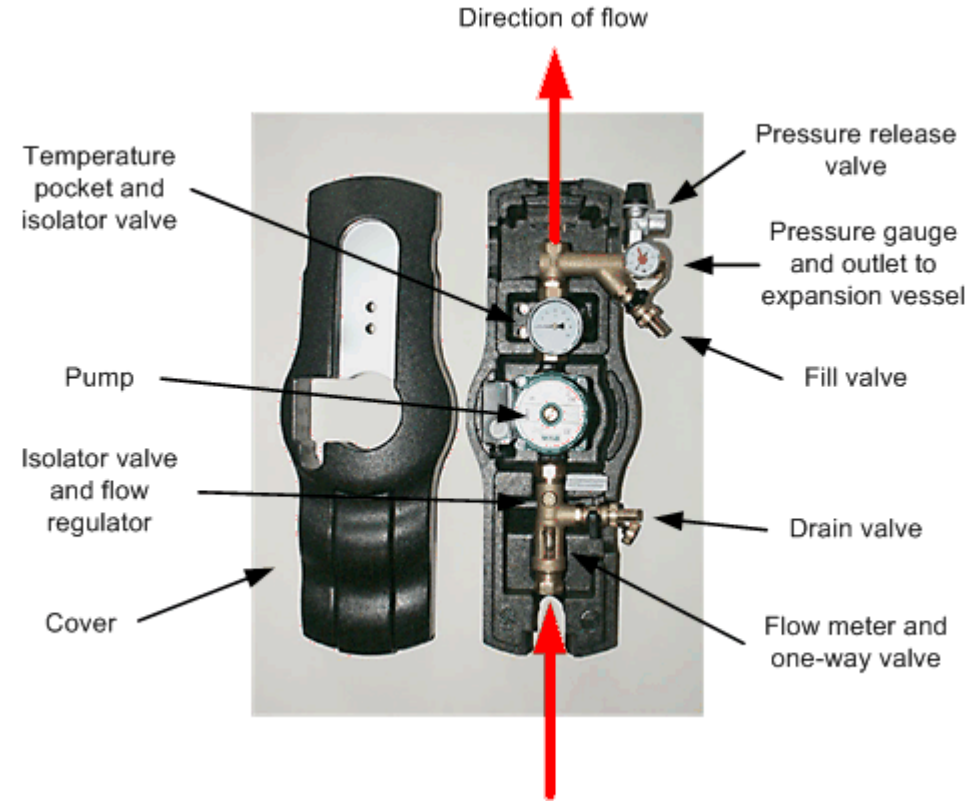

Figure 1: The Pump Set

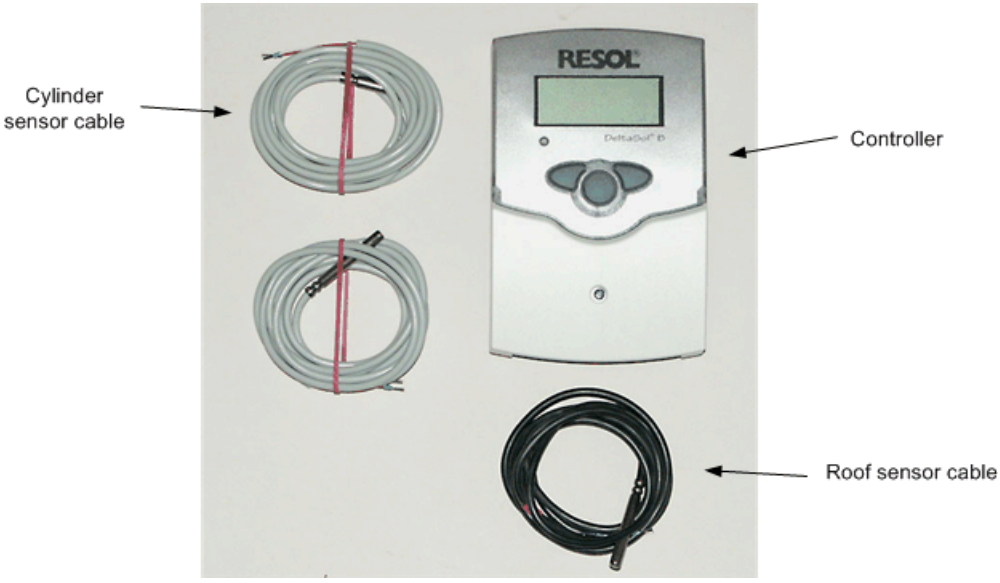

Figure 2: The Controller

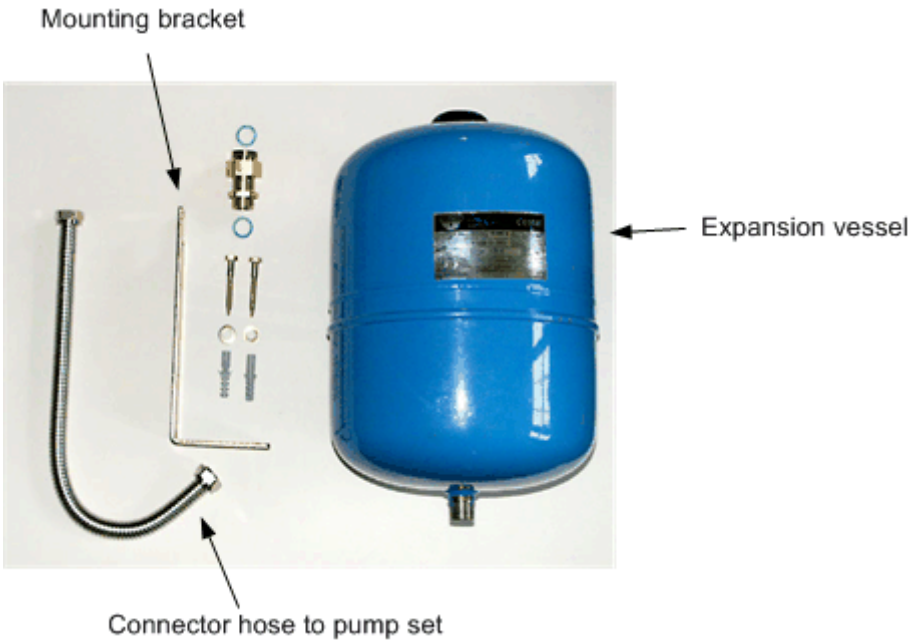

Figure 3: Expansion Vessel

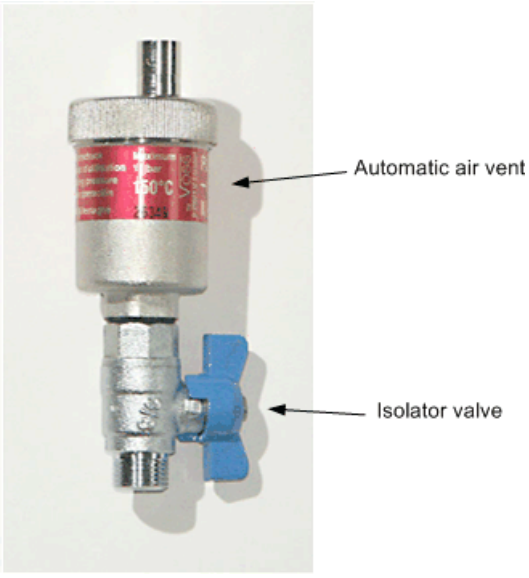

Figure 4: Automatic Air Vent and Isolator Valve

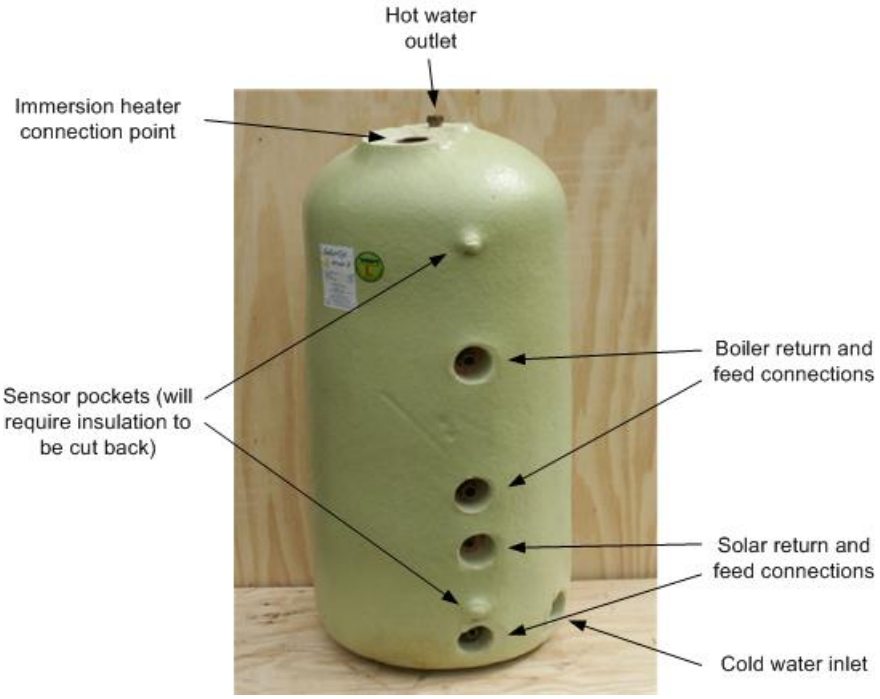

Figure 5: Twin-coil Cylinder

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4 Diagram of Plumbing Layout of System for Twin Coil Vented Cylinder

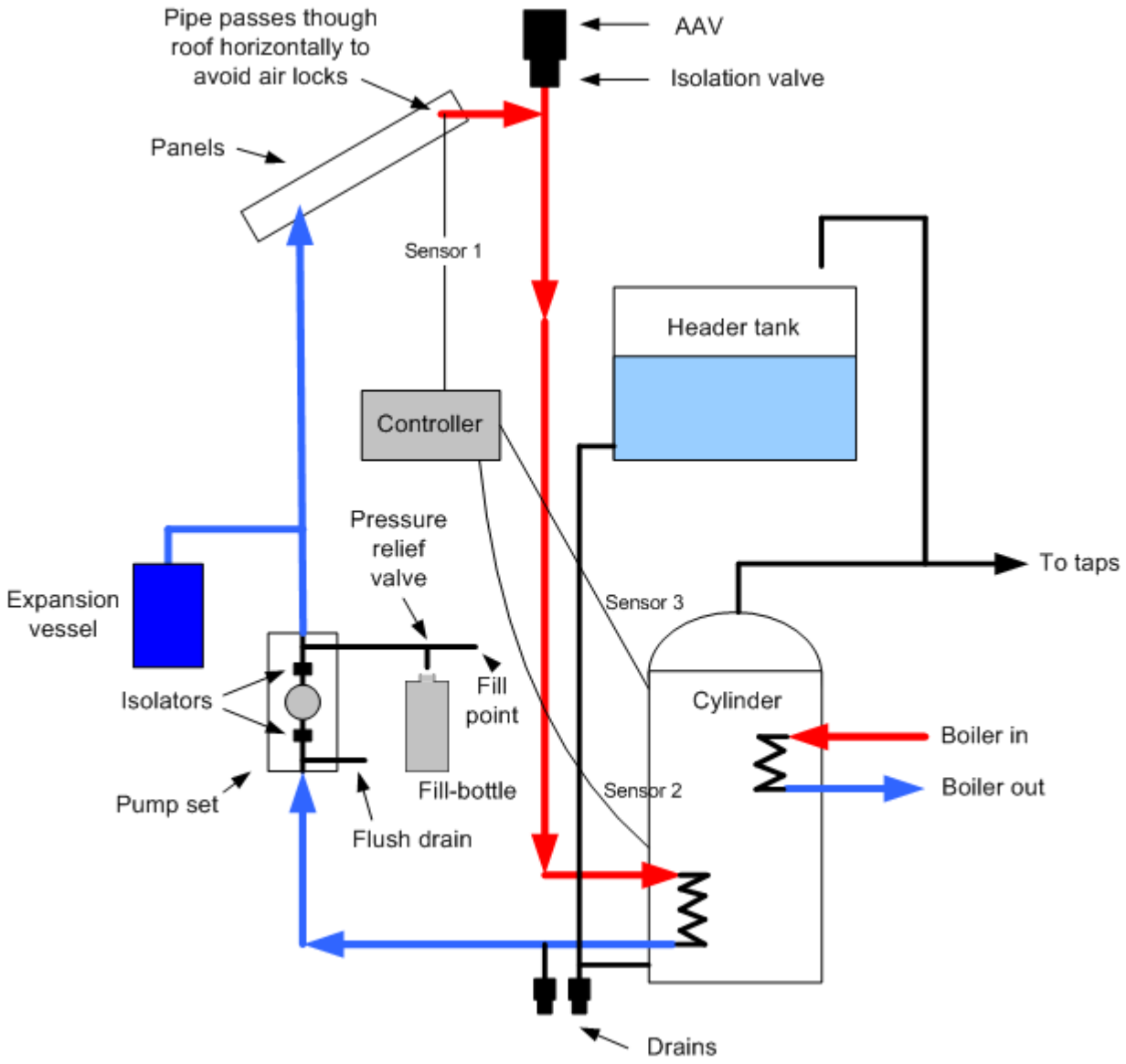


Diagram 1: LILI-ES Solar Hot Water System Plumbing Layout for Twin Coil Vented Cylinder

4.1 Plumbing Installation Instructions for Solar Circuit

These instructions assume a reasonable level of competency in plumbing. All work must be carried out according to best practices.

All pipe work on the solar circuit is to be in 15mm copper with either compression joints or solder joints using high temperature solder rated for 170ºC temperatures. All insulation is to be Armaflex HT with pipe clips rated for the same temperature – either brass or saddle bands (40mm) that go

over the outside of the insulation. Use hemp and 'white' type compound on joints in preference to PTFE. Although PTFE tape is acceptable it tends to allow more leaks than good old fashioned hemp and hawk white. The system fluid has a lower viscosity than water and is better at finding leaks than water.

Ensure that all pipe work can be drained of fluid i.e. provide drain cocks for any section of pipe that doesn't drain to the main drain cock at the bottom of the circuit.

Avoid creating air traps where air bubbles will congregate during operation. Ensure the system is installed so that air can rise through the system to the automatic air valve (AAV).

Place the pump set and expansion vessel on the 'cold' side of the circuit to minimise thermal stress.

Ensure that the expansion vessel static pressure is set to 1.75 Bar. To do this, remove the black cap at the bottom of the vessel exposing an air valve (a car tyre air valve). Using a foot pump or tyre pressure gauge adjust pressure to 1.75 Bar. Ensure this value is marked on the vessel's label for future reference (most vessel are charged to 3 Bar).

Mount the expansion vessel with the plumbing connection uppermost (to allow air and vapours to escape). Connect the vessel with a pipe that rises from the connection on the cylinder to join the circuit (at a point higher than the vessel) – see diagram 1. This prevents heat being transmitted up into the vessel. The expansion vessel membrane must be protected from temperatures above 90ºC.

The pressure gauge on the pump set must be fully screwed in to get a reading (no compound is required on the thread).

We recommend that the filling bottle be used as the blow-off vessel (remove the top).

5 Electrical Wiring Instructions

These instructions assume competency in the field of electrical installations. Electrical work must be carried out by competent people who fully understand what they are doing. Work must be undertaken to comply with BS7671 – Requirements for Electrical Installations. Do not take risks with electricity.

The electronic controller is the 'brain' of the system and requires a 240 Vac (normal house electrics) power supply for it to function. The controller then uses a low voltage to monitor the sensors and it switches the pump, which also runs on 240Vac.

The controller must be supplied via a switched fused spur that is fitted with a 3 Amp fuse. The spur must be clearly and permanently marked with the text '3 Amp Only'. The spur must be cabled with a conductor whose size relates to the fuse size (in the consumer unit). A circuit with a 6 Amp fuse requires 1mm² cables, a 20 Amp fuse requires 2.5mm² cables, and a 32 Amp fuse requires 4mm² cables. Twin and earth cable (T&E) is required for this connection. The spur can be connected to an immersion heater circuit (in perhaps an airing cupboard) or it can be connected to a lighting circuit as long as the lighting circuit isn't running at capacity.

Wire the controller according to the manufacturers instructions.

Use heat proof cable between the controller and the pump.

The sensors are not polarity sensitive and thus can be wired any way round. Twisted pair type single insulated cable is good but bell wire will suffice for sensors. Do not run sensor cables alongside 240Vac cables as they can suffer interference.

Wire the pump according to manufacturers instructions.

5.1 Electrical Wiring Diagram

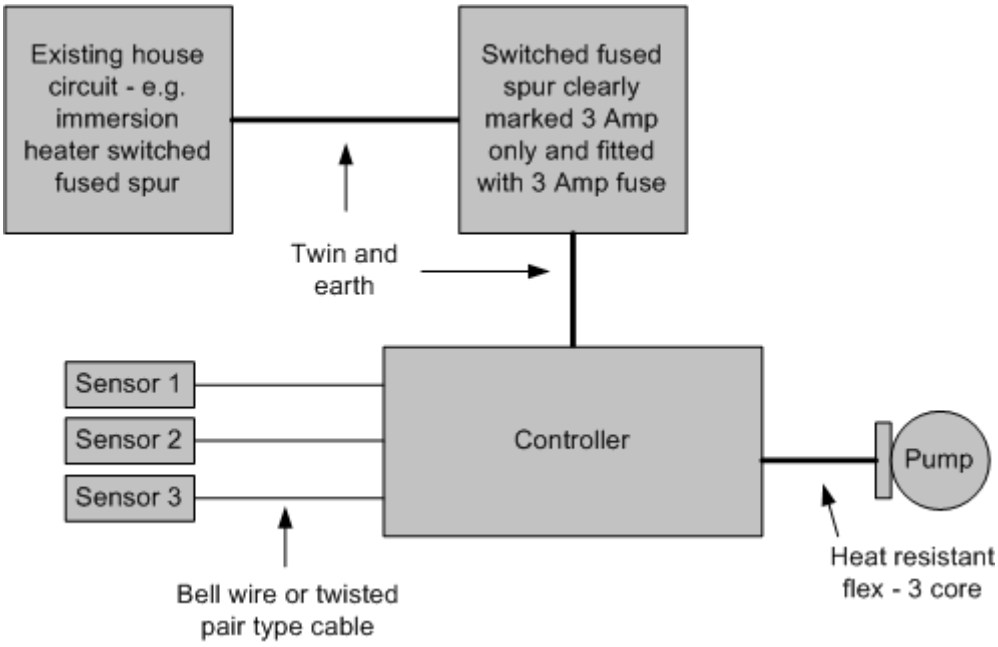


Diagram 2: Wiring Diagram

NB The third sensor monitors the temperature at the top of the cylinder and operates the over-temperature cut-off.

Ensure earth cross bonding of pipes if they are located in a bathroom

6 Roof Mounting Instructions

These instructions are written for people who are familiar with roof structures and working at height. If you are unsure regarding safety issues do not risk injury and seek the advice of professional installers. We recommend the use of scaffolding that offers a platform below the entire operation on the roof.

The SUNLILI 2 panel incorporates 10mm sliding bolts to facilitate fixing the collectors onto the roof. The panel is supplied with all the necessary fixing bolts and washers (all stainless steel).The collectors are fixed onto the roof by means of an aluminium angle section (long piece of angled metal). This angle section is fixed through the roof surface into rafters – never batons. This arrangement gives excellent strength and if the job is undertaken properly will be weather tight for the life of the roof.

6.1 Mounting Procedure

CAUTION: the panels may contain small amounts of water which will become very hot as the panels are mounted on the roof. Take care to prevent scalding.

Having decided on the configuration of panels:

For each panel 4 fixings are necessary: two in the top section and two in the bottom. Measure out fully the locations of all panels, rafter locations, and holes for pipe penetrations before commencing drilling. Mark in chalk. Align panels horizontally with tiles or slates.

Drill 8mm holes in the angle section that correspond to the rafters on the roof. Two or three layers (slates or tiles) will be met before the drill bit penetrates the sarking felt. Next drill 11mm holes in the upstanding section for the bolts that fix to the panel. These should be drilled so that the bolts fix to near the outside edges of the panel (50-100mm from the edges if possible).

Locate rafters – if the roof tiles are concrete then they should push up to reveal the batons and rafters below. If the roof is slated then the rafters can be found by looking for where the soffit boards are nailed onto the ends of the rafters.

Alternatively don't bother finding rafter and just drill through the roof where required. Locate the holes inside the roof space and screw or nail pieces of wood (no smaller than 75x50mm, sawn – tannalised is best) in the corresponding location under the hole. Ensure the wood aligns with the top of the rafters – right against the sarking felt. Ensure these 'noggins' are well fastened to the rafters. The angle section is fixed into the noggins.

For concrete tiles a masonry drill bit can be used but without the hammer action (hammer can be used but with care – just a tickle). On clay tiles (usually small and reddish in colour) use tungsten spear shaped glass/tile bits and keep them cool by dipping them in water. Alternatively use wet diamond drilling equipment for best results.

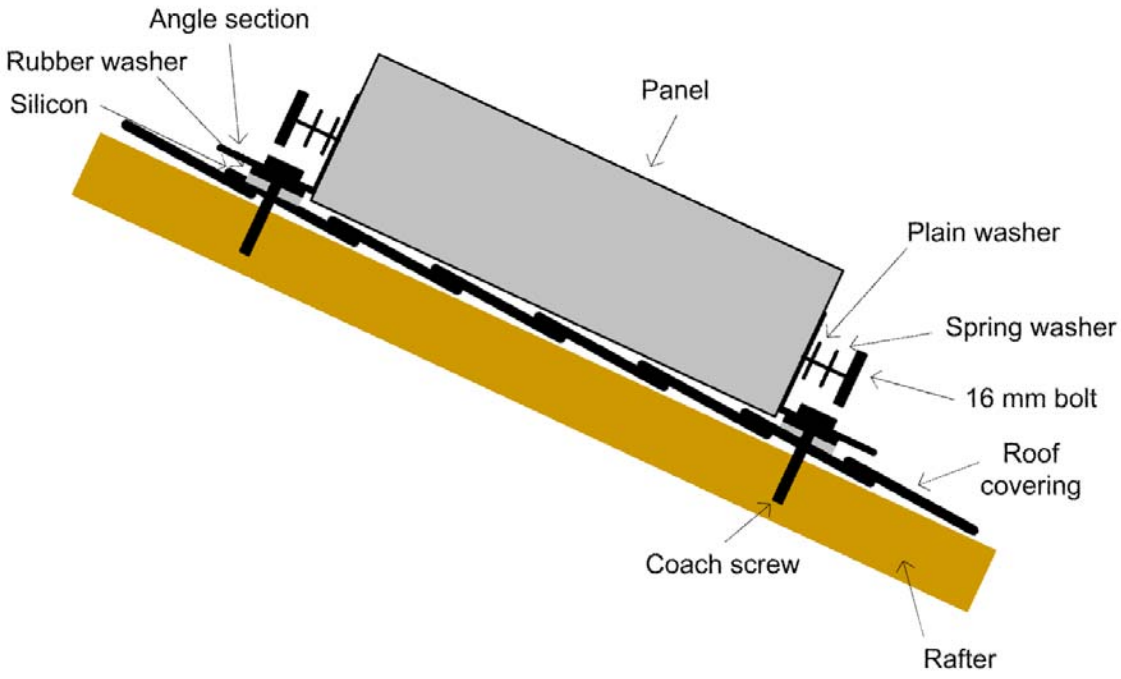
Having drilled the holes in the roof cover, puff the dust away using a puffer or bicycle pump. Brush all dust from the surface. Inject clear low-modulus silicone sealant well down the hole, slowly pulling the nozzle upwards so that the hole is filled with sealant. Then work the sealant around the hole (on the roof surface) to a diameter of about 30mm. Spend time working the silicone onto the

surface with the nozzle so that the silicone is really well contacted onto the surface. Build up the silicone so that it is about 5mm high.

Onto the silicone place the rubber washers and again spread these with silicone (not so much this time) before placing the angle sections on the rubber washers. Place the fixing bolt – 120mm stainless coach screws are best through the hole in the section down into the silicone filled hole using a spanner or ratchet handle until tight, with the washer being compressed ever so slightly. Apply silicone around the pipes in a similar way.

Now bolt the panels in place using the bolts provided. It is important that all the washers are used including the spring washers. Use the puffer to blow any debris from the sliding nut slot as the nut will tend to jam if debris is present. Do the bolts up tight enough to compress the spring washer.

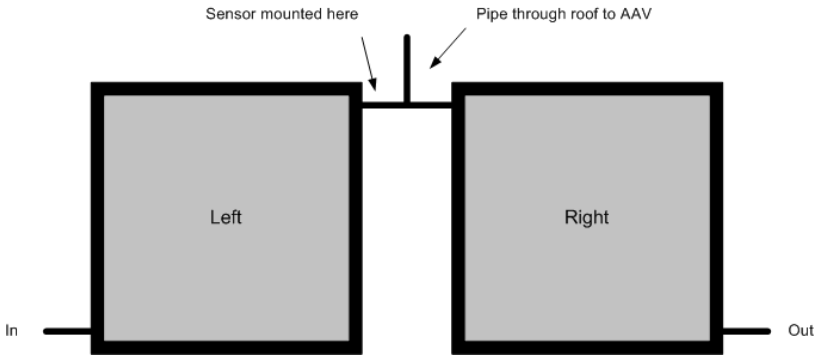
6.2 Roof Mounting Diagram



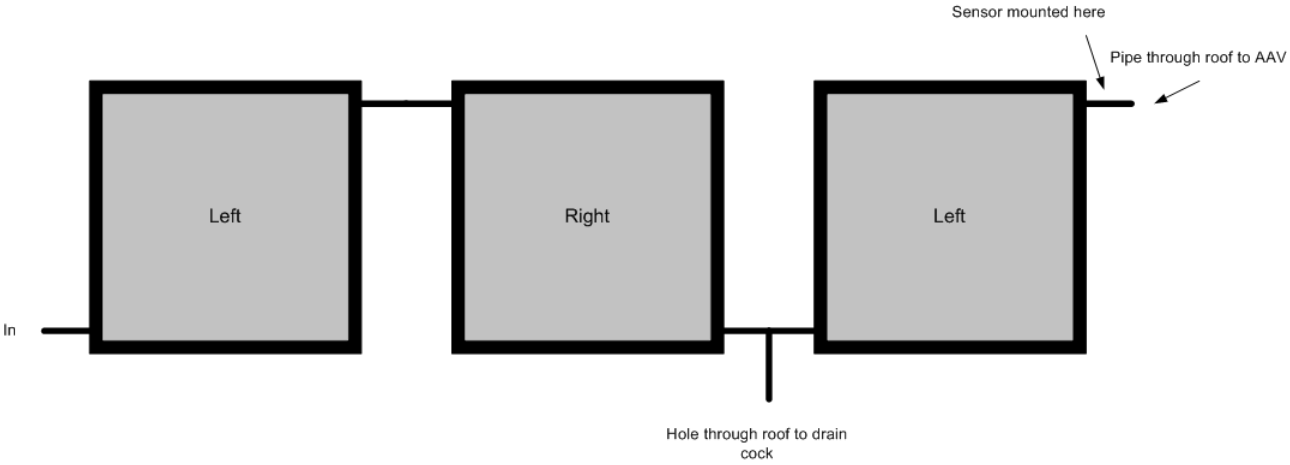
6.3 Configuration of Panels on Roof

Panels can be either in series or parallel. No more than 4 panels may be used in series without prior permission from LILI-ES Ltd. All panels must be able to drain. Panels can be either left or right handed and must be ordered accordingly.

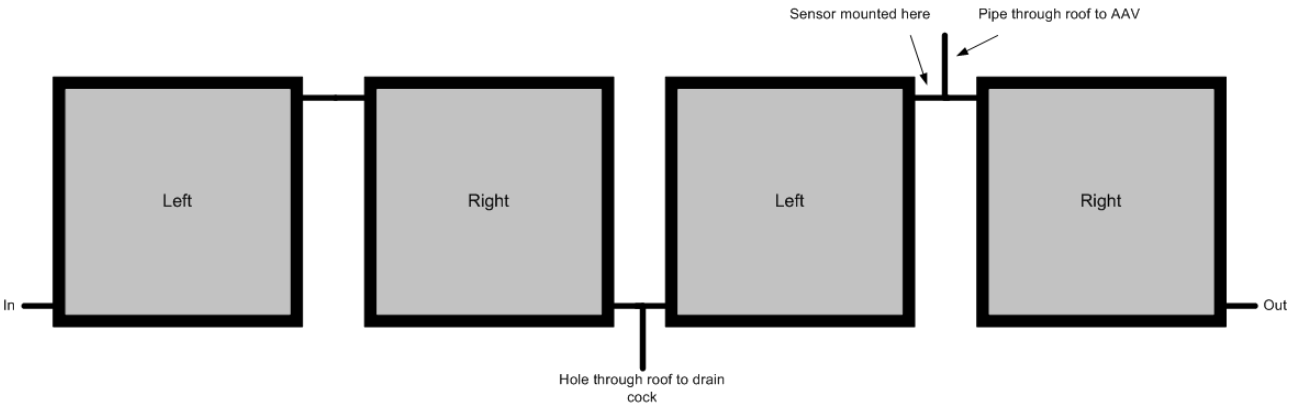
6.3.1 Two Panel System



6.3.2 Three Panel System



6.3.3 4 Panel System



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7 Commissioning Procedure

Ensure all pipe-work is sound and other components are tight such as pump unions etc.

Ensure the screw on the top of the AAV is opened a few turns to allow air to escape. Check drain cocks are closed.

Using a spanner turn the check valve on the pump set (located by removing thermometer) 90 degrees to isolate pump at the top and turn the flow regulator so that the slot is at 90 degrees to the pipe. This isolates the pump at the bottom.

Attach a garden type hose to the fill point (top hose barb) that can be fed by a tap (preferably mains). Attach a second length of garden hose to the bottom hose barb that is long enough to reach a drain (toilet or bath if in the airing cupboard). Ensure valves (with black handles) are open.

Turn the tap on and flush the system through for a few minutes to remove flux or debris from the plumbing process. Turn off the tap and remove the top hose. Place a very short length of hose on the bottom barb and provide a bucket for it to issue into.

Unscrew the hose barb on the pump unit fill point and attach the fill-bottle flexi-hose to the connection point – use PTFE. Attach the other end of the flexi-hose to the top of the fill-bottle.

Fill the bottle with the pink collector fluid and screw the bottle onto top of the fill-bottle. Pump in the pink fluid. It will push water out of the system. When pink fluid has started to appear in the bucket (most systems use less than 5 litres) close the valve at the bottom outlet.

Open pump isolators (above and below pipe) and pump in fluid until the pressure reaches 2 Bar. Leave the check valve at a quarter turn to hold it open to ensure de-gassing (removal of air).

Switch the pump on to continuous running at full speed and operate until all air is out of the system – when the pump will run very quietly. Set the pump to the slowest speed and the flow regulator so that the top of the marker reads 1 litre per minute per panel i.e. for 3 panels – 3 litres per minute.

Isolate the AAV.

Switch the controller off and set it to switch on at a 5 degree temperature difference. Ensure the maximum store temperature is set to 60 degrees C.

Turn the controller back on. The system should now be up and running.

Ensure the cylinder reaches 60 degrees at least once a day to sterilise legionella bacteria.