

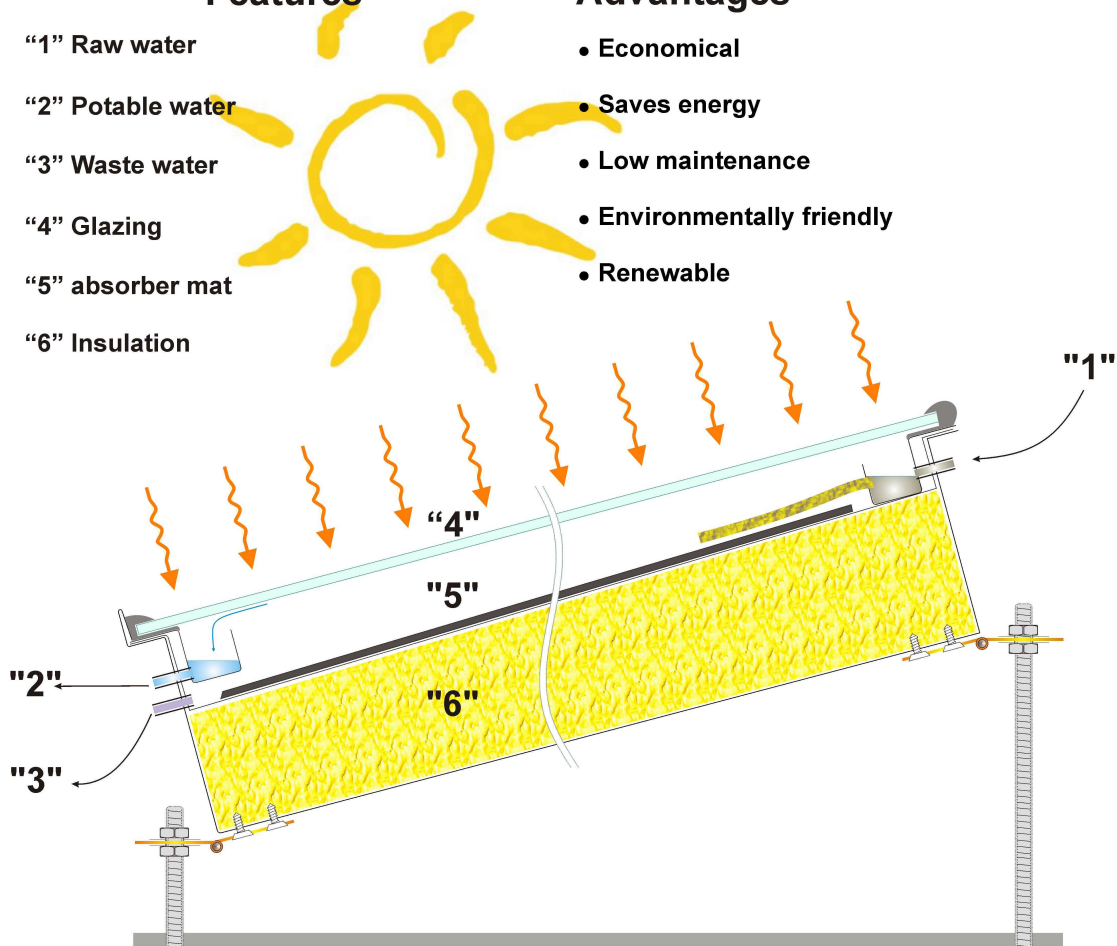
Installation manual for family sized solar distillation systems

Features

- "1" Raw water
- "2" Potable water
- "3" Waste water
- "4" Glazing
- "5" absorber mat
- "6" Insulation

Advantages

- Economical
- Saves energy
- Low maintenance
- Environmentally friendly
- Renewable



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1 Part lists

The family sized solar distillation system consists of the following components:

Table 1: Piece list

List No.	Item	Weight in kg	Quantity
1	Distillation collector, including hinge bracket, Over-all dimensions: 2.51m x 1.05 m, gross area 2.64 m ² , Absorber area 2.5 mm	60.4	1 piece
2	Rear spacing beam, galvanized steel, length 2.5 m	--	1 piece
3	Front spacing beam, galvanized steel, length 2.5 m	--	1 piece
4	Thread rod for rear support, diameter 8 mm, length approx. 40 cm, incl. 2 x washers 30/10 mm, 2 x nuts 8 mm	--	3 pieces
5	Thread rod for front support, diameter 8 mm, length approx. 20 cm, incl. 2 x washers 30/10 mm, 2 x nuts 8 mm	pos. 2-5 4.8	2 pieces
6	Solenoid valve, 12 v / 0.8 A, 3/4 - 1/2" connections	0.42	1 piece
7	Photo sensor	0.1	1 piece
8	Controller unit	0.67	1 piece
9	Solar module, 12 V, 10 Wp,	1.3	1 piece
10	Mounting bracket for solar module	0.9	1 piece
11	Solar cable 1 x 1.5 mm ²	--	5 meters
10	Rechargeable battery, 12 V, 5 Ah	1.9	1 piece
11	Installation cable 7 x 0.8 mm	--	10 meters
12	Distillate storage tank, 45 litres, pipe connections & overflow sensor	4.1	1 piece
13	Activated carbon filter (for start-up)	0.2	1 piece
14	Pressure reducer, 4 l/h flow rate, 5 mm nozzle	--	2 pieces
15	90° elbow for 16 mm PE piping	0.05	5 pieces
16	Branch connection, 5/5/5, for connection pipe 6/4 mm	--	1 piece
17	Plug nipples, 6 mm	--	4 pieces
18	Connection piping, 6/4 mm, black PE	0.54	2 meters
19	Condensate piping, 6/4 mm, transparent	0.36	10 meters
20	PE piping 16/1 mm, black PE, for waste water	0.07	10 meters
21	Pipe plug for 16 mm PE pipe	--	1 piece
22	3/4" pipe connector, for pipe connection to solenoid valve	--	1 piece
23	16 mm – 3/4" bushing, for pipe connection to solenoid valve	--	1 piece

2 Collector installation

Installation site:

The distillation collector can be installed on a flat roof or on open ground e.g. in a garden. The chosen site must receive sunlight throughout the whole day. Please take into consideration, that shading can differ between summer and winter.

Concrete Foundations:

When installing on open ground make sure to prepare appropriate fundamentals. Prefabricated tapered concrete blocks are a well-proven solution. These blocks can be made easily on site using 5 litre plastic buckets as reusable casing. Make sure that the concrete is fully bound before installation. Alternatively standard concrete paving slabs may be used.

Installation of substructure:

The substructure consists of foundations, thread rods, as well as nuts and washers. To install the substructure adhere to the following instructions:

1. Drill a 70 mm hole with a 10 mm drill into the centre of each foundation.
2. Cement thread rod into each foundation (fig #1).
Alternatively: insert a plastic wall plug into the hole in the foundation and screw a hanger bolt into the plug. Connect thread rod with threaded bushings to hanger bolt.
3. Place supports lengthwise in a east-west alignment, with the three rear supports (40 cm thread rods) and rear spacing beam (with three holes) placed to the north when installed in the northern hemisphere; and to the south when installed in the southern hemisphere.
4. Use spacing beams to position equipped foundations on site as shown in fig. #2.
5. Dig holes for tapered foundations if installing on open ground. Place foundations in the prepared holes making sure that the foundations are placed on the same level, and that the upper surface of the foundation is approx. 5 cm above ground level.

Mounting of collector:

Adhere to the following instructions, to mount the solar distillation collector - as shown in fig #3 - upon the prepared substructure:

1. Twist nuts onto each thread rod, approx. 5 cm below upper edge, and place a washer upon the nut. Washers of rear supports are to be placed 26 cm higher than the washers of front supports to achieve a 15° inclination of the collector. Align rear washers to the same level. Align the front washers to the same level.
2. Remove tape from the hinged brackets and place the brackets over the thread rod. Thread rod protrudes through holes in each bracket. Place washers over threaded rods onto the hinged brackets and screw down with nuts per hand.
3. Align foundations so that threaded rods stand vertically. Fill in foundation holes and compress soil when installing on open ground.

4. Tighten nuts with a wrench.

Fig 1: Equipped foundation

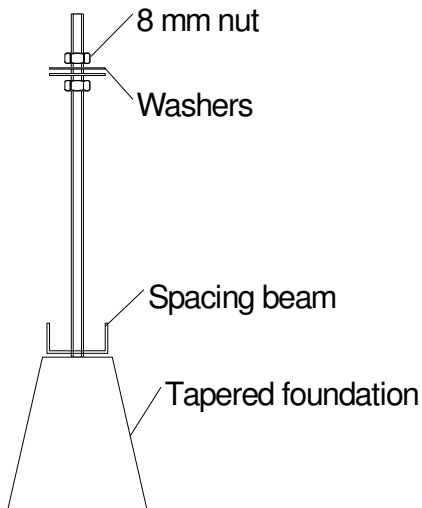


Fig 2: Foundation positions

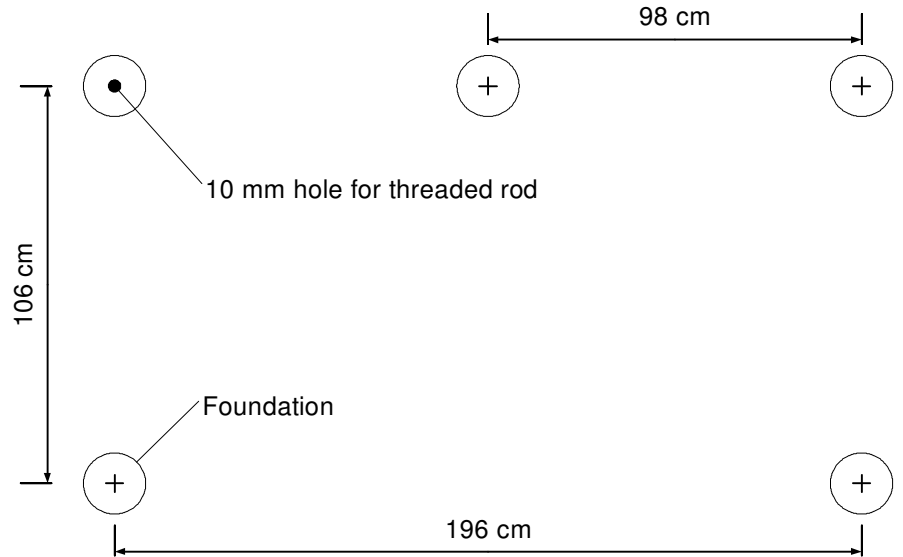
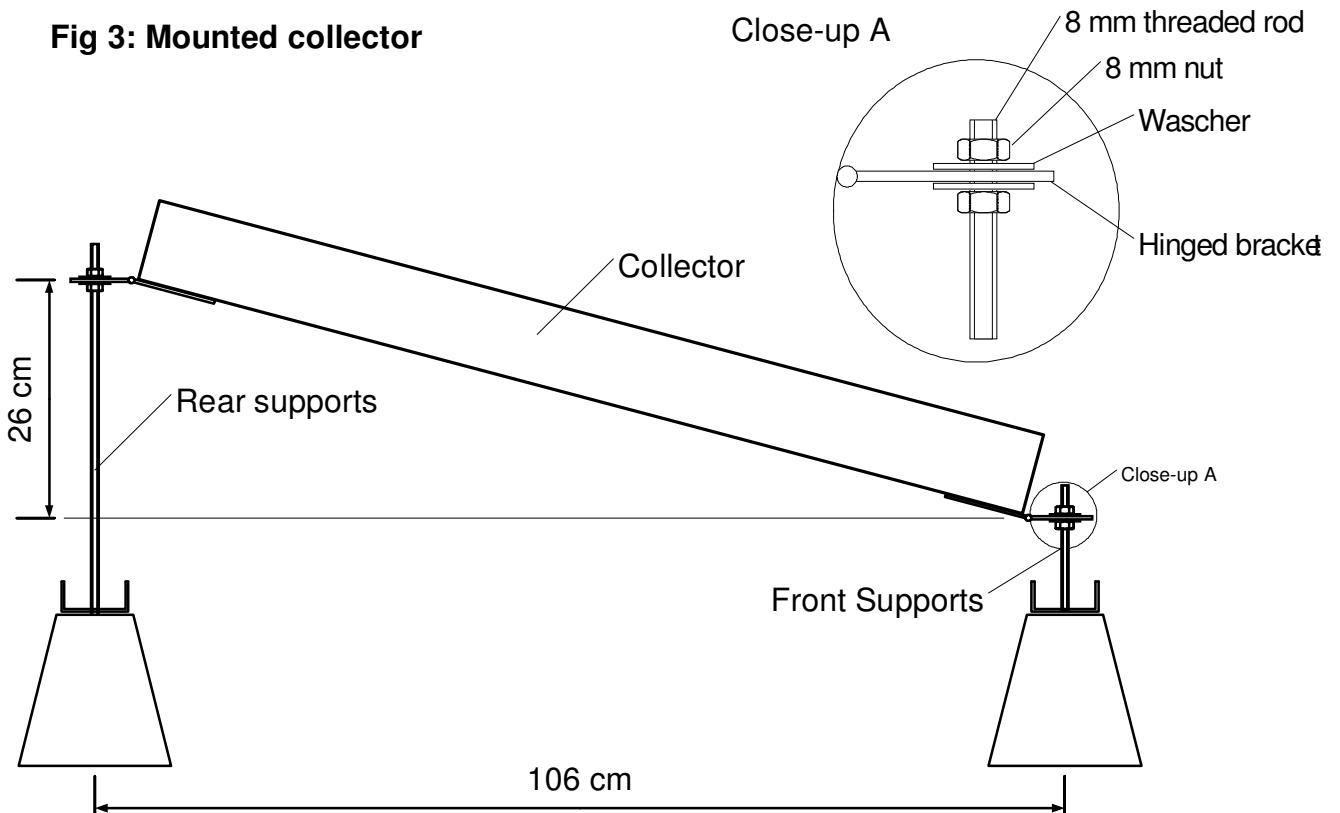


Fig 3: Mounted collector



3 Electrical installation

The distillation system is supplied with an electronic controller. A PV module supplies power to the controller. Integrated in the controller are a rechargeable battery and a battery charge controller. The control unit measures solar radiation via a phototransistor, and triggers the solenoid valve to feed the collector with raw water depending upon measured radiation. The number of charge cycles per hour is therefore dependent upon weather conditions. Good weather with plenty of sunshine leads to high production rates. This active control feature ensures the excellent production rates of this system.

Photovoltaic module

Install the PV module near the distillation collector in a shade-free location. The Module should be aligned in the same direction as the distillation collector i.e. facing to the south in the northern hemisphere, and facing to the north in the southern hemisphere.

Use wall bracket to install the photovoltaic module to a wall or post:

1. Screw mounting bracket to a wall or a post.
2. Connect module beam to the mounting bracket, using the supplied nuts & bolts.
3. Choose one of the following inclination settings:

Latitude of installation	Inclination Setting
25° south– 25° north	15°
25° - 45° north, or south	25°
Greater than 45° north, or south	35°

4. Mount PV module to module beam, using the supplied nuts & bolts.
5. Connect PV module to controller unit with an appropriate installation cable. Use UV resistant cable for outdoor installation.
6. PV module can also be connected to controller unit via solenoid valve, as shown in wiring diagram.

Mounting of the controller:

Install the electronic controller in an accessible place, which is however safe from playing children. Adhere to following instructions to mount controller:

1. Unscrew the controller cover and unplug leads to circuit board.
2. Mark the circuit board guide and carefully remove circuit board from casing. Take care to touch only the terminal block.
3. Drill at least two mounting holes through the middle of circular lugs located on the back of the casing.
4. Hold the terminal box against the mounting surface and mark the location of the screw holes through the prepared mounting holes. Use a pencil or a centre punch to mark the location of the screw holes.
5. Drill holes in the marked locations.

6. Secure the terminal box to the mounting surface with appropriate screws.
7. Mount the empty casing to a wall with the cable conduits facing downwards.
8. Insert circuit board back into marked guide.

Wiring instructions

1. Strip cable ends of insulation (5 mm). When inserting cable ends, make sure that naked wires do not cross, and that insulation is not clamped in the terminal.
2. Connect wires to terminal block according to wiring table and wiring diagram.
3. Insert the rechargeable battery into the controller casing. Make sure that all terminals are connected according to the wiring table and then connect leads the battery terminals. Red terminal is all ways positive; blue or black terminal is negative.
4. Switch leaver on controller cover to off. Insert terminal bar into socket on cover and fasten cover to controller casing.

Table 1: Wiring table

Terminal pair	Function	Installation instructions
F+(Fotovoltaica)+ F-(Fotovoltaica)--	Terminals for PV module	Check polarity of leads from PV Module before connecting.
V+(Inyección)+ V-(Inyección)-	Terminals for solenoid valve or injection pump (optional).	Injection pump (optional) may pump in the false direction if polarity of leads is reversed. Reversed polarity dose not affect solenoid valve.
L (Fototransistor) L K (Fototransistor) K	Terminals for radiation sensor (phototransistor).	Install radiation sensor on top of one of the thread rod supports. Make sure that the sensor is installed shade-free. Connect L and K leads of the phototransistor respectively to the L and K terminals in the control unit. Sensor can be connected to controller via solenoid valve as shown in wiring diagram.
-- Valvula recirc. -- + Valvula recirc. +	An overflow pump (optional) prevents distillation tank from overflowing, and pumps distillate back to the raw water tank, or an auxiliary tank.	Check polarity of leads from bypass valve before connecting. Alternatively an overflow drain (e.g. 16 mm PE piping) can be installed between the distillate tank to an auxiliary tank or a drain.
Sensor~ Sensor~	Terminals for overflow sensor in distillate tank. The overflow pump (optional) is switched on, as soon as a set water level is surpassed.	The sensor consists of two stainless steel bolts at the top of the distillation tank.
+Bomba agua destil.+ +Bomba agua desti.-	Terminals to distillate pump (optional). This is switched on by: <ul style="list-style-type: none"> • a pressure transducer, or by • a tap with integrated micro-switch, when water is tapped 	Check polarity of leads from distillate pump before connecting. Distillate pump specifications: Voltage : 12 V (DC) Current : 1,5 Amps
Interruptor de presión Interruptor de presión	Terminals for a pressure transducer, or a tap with integrated micro-switch.	
Libre (=V --)	Control function for large collector arrays.	Not applicable for family sized systems.

4 Piping installations

A standard piping installation is shown in the piping diagram at the back of this manual. Installation conditions may differ considerably from site to site. However the following features must always be taken into consideration when installing the system:

Raw water supply

- Raw water supply is regulated with the solenoid valve. Connect the raw water supply to the $\frac{3}{4}$ " connector of the solenoid valve. A standard washing machine hose can be used to connect the raw water supply to the solenoid valve. A $\frac{3}{4}$ " pipe connector and a 16mm- $\frac{3}{4}$ " bushing are supplied and can be used to connect 16 mm PE pipe to the solenoid valve.
- Town water can be connected directly to solenoid valve, if supply is reliable.
- We recommend that raw water is stored in a cistern, if town water supply is unreliable, or if the water is supplied by a PV pumping system (also available from SUNSET solar), or by some other means. Install the cistern behind or next to the collector to prevent shading of the collector, phototransistor, or PV module. The water level in the cistern has to be at least one meter higher than the inlet of the collector.
- Make sure that raw water is free of particulates and mud. Water from wells (brackish water and sea water) is usually well filtered. We recommend that surface water be pre-filtered before use in the distillation collector.
- Connect the solenoid valve to the collector with 6 mm connection tube. Install a branch connector below one of the raw water inlets. Lay two 6 mm connecting tubes from the branch connector to the two raw water inlets at the back of the collector.
- Install pressure reducers in the connection tubes leading to collector inlets. The red side of the pressure reducer faces towards the collector if supply pressure is lower than 0.5 bar (5 metres pressure head). The red side faces away from the collector if the supply pressure is greater than 0.5 bar.

Distillate installations

- A plastic cistern is supplied with the system to store the produced distilled water. This tank should be placed in the house, preferably in the kitchen and above the drinking water tap. The distillate tank can be installed in cupboards or below the ceiling. Take the considerable weight of approx. 45 kg into account when choosing an installation site.
- Lager distillate tanks should be installed on an even and sturdy foundation. In this case it is usually necessary to install a distillate pump.
- Distillate outlets at the front of the collector are marked blue. Seal an outlet. The outlet can be sealed by sticking a piece of 6 mm piping over the outlet, and then bending the plastic pipe over, and affix the pipe ends together with scotch tape. Lay distillate pipe from the other distillate outlet to the distillate tank.

- Install the activated carbon filter in the distillate piping. The filter removes residues from production and installation in the initial days of operation. The filter remains in place though out the working life of the system and dose not have to be replenished.
- Water installations have to comply with national and international standards.
- A tap with integrated micro switch can be used to operate a distillate pump, if the distillate tank is installed on a lower level. The distillate tap (drinking water tap) is often placed in the kitchen as a second tap at the kitchen sink.

Wastewater installation

- Approximately 50% of the raw water passes the collector as wastewater, 50 % is evaporated to produce the distilled water. The wastewater ensures that the collector stays free of salt and minerals.
- Wastewater outlets at the front of the collector are marked red. Connect the wastewater outlets to a 16 mm PE wastewater pipe with 6 mm connecting tubes and plug nipples. Place the waste water pipe in the trough of the spacing beam. Pierce a hole in the 16 mm PE pipe with a small screwdriver. Insert plug nipple into 16 mm pipe and stick the 6 mm connecting tube over the protruding end of the plug nipple.
- Wastewater can be used for irrigation, and for washing if the system is operated on freshwater.
- Wastewater may be used for washing if the system is operated on brackish, depending upon salt concentration.
- Wastewater has to be disposed if operated on seawater or high concentration brackish water. Dry wells or drainage pipes are suitable to dispose of wastewater. Both should be installed as far as way as possible from the raw water well as possible.
- Use plastic pipes for wastewater installations, because of corrosive properties of the wastewater.

5 Commissioning

Commissioning of distillation system

Commissioning of the system is faster and easier when carried out in the early morning before the collector receives full sunshine.

1. Check that solenoid valve is under pressure.
2. Remove connection tubes from outlets, so that water can freely drain out of the collector. Brine (wastewater) may have to be collected in a bowl or bucket.
3. Set the control knob (injection duration) to 20 s.
4. Set the main switch to 'Manual' for two to three minutes and then to 'Auto'. Repeat every ten minutes until the 60 to 80% of the absorber mat is moistened. Then set main switch to 'Auto'.

5. Check if absorber mat is moistened evenly. If one side is dry then adjust the collector by lowering the dry side and lifting the moister side. Only use the rear supports to adjust the collector. Adjust hinged brackets with nuts on threaded rod to a new position and re-fasten brackets.
6. Reduce the injection duration every ten minutes by five seconds until the wastewater flow is reduced to a drop or two a second (up to 40 ml/min).
7. Place vessels below distillate and wastewater outlets. Operate for at least two hours. Determine amount of collected water. The amount of collected distillate and wastewater should be approx. equal. Reduce injection duration if more wastewater is collected than distillate. Increase injection duration if more distillate is collected than wastewater.
8. Check on the second day during good sunshine, if the absorber is still evenly moistened. If one side is dry then readjust the collector.
9. A moist upper part and dry lower part of the absorber mat indicates a lack of raw water. In this case the injection duration has to be extended by 5 seconds to feed enough raw water into the collector. If necessary, the injection duration may have to be reset again on the following day.
10. A build-up of a salt crust also indicates a lack of raw water, when operating with seawater. In this case the salt crust has to be washed out before the injection duration is increased. To wash out the salt crust set the main switch to 'Manual' for two to three minutes and then back to 'Auto'. Repeat every five minutes until the salt crusts have been reduced considerably. Then increase the injection duration by 5 seconds.
11. Dirt may accumulate in the raw water trough after several weeks of operation, and may also stain the wicks, particularly if the water has high iron content. These stains however do not have any noticeable affects on the distillation process.
12. Be ware not to over fill the collector; wastewater may not be able to drain off fast enough, leading to a flooding of the distillate trough with wastewater. Danger of flooding only arises if the injection duration is far too long or if the main switch is switched to 'Manual' for a longer period of time.

Commissioning of distillate pump (optional)

1. Set the pump switch to 'OFF' position before commissioning.
2. Check if there enough is distillate in the distillate tank; dry operation will damage the pump.
3. Set the pump switch to 'Auto' position.
4. Open tap with integrated micro-switch. Water must flow out of tap with in a few seconds.
5. Check if pump works when pump switch is switched to position 'Manual'

6 Operation & Maintenance

This distillation system is completely automatic, and, once commissioned, needs no further adjustments of controls.

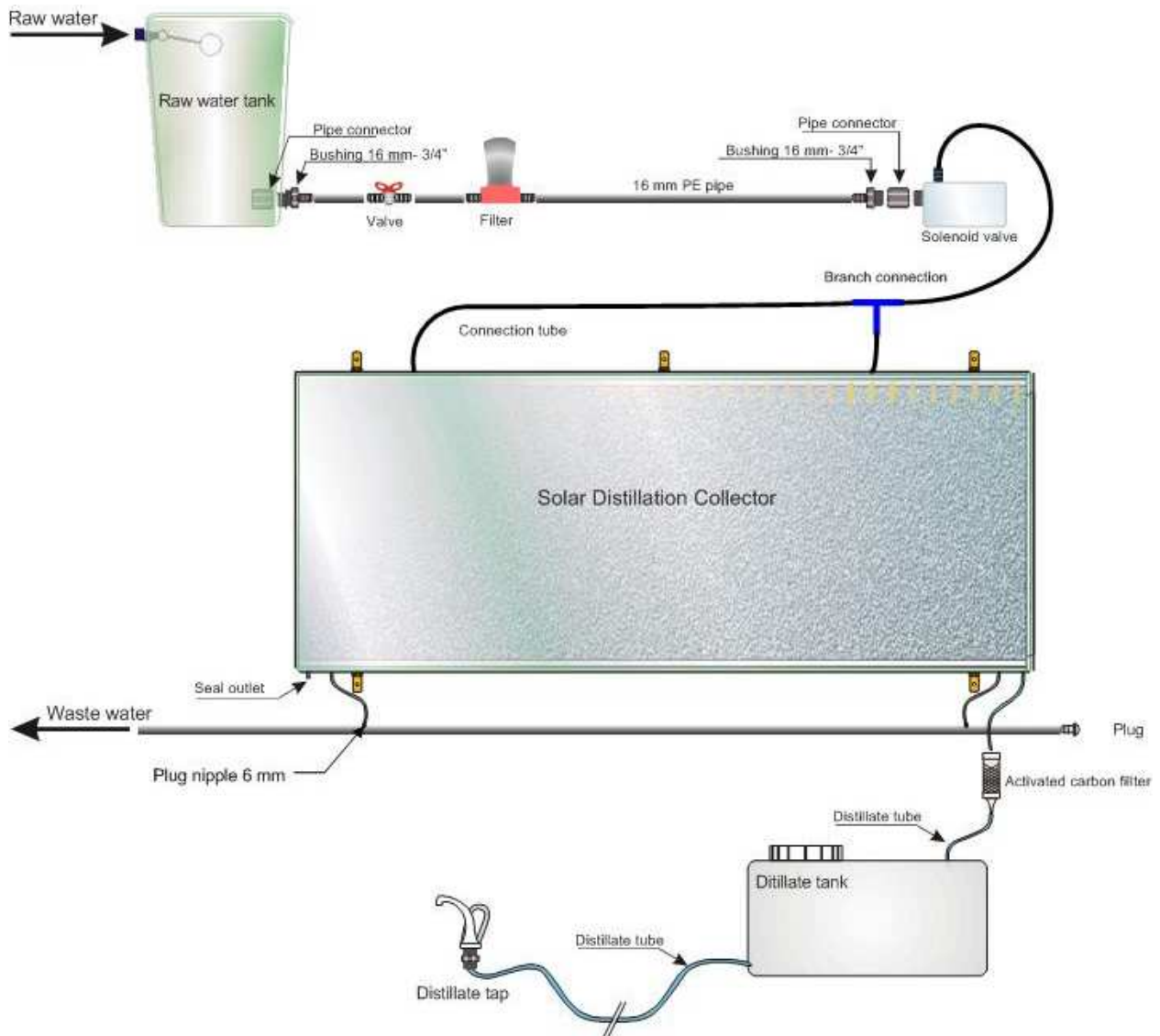
LED Lamps on the front cover of the control unit show the operation mode of the system:

Lettering / Position	Lights up when:	Remarks
Inject	solenoid valve opens to feed raw water into collector.	
Battery	battery is charged to 13.7 V.	Solar module recharges when battery voltage drops to 13.5 V
Sensor	sensor is ready for operation.	LED is only off when distillate tank is full
Next to main switch	switched to position "Auto" or "Manual".	
Next to pump switch	switched to position "Auto"	If LED dose not light up then the pump is defect or the cable is damaged; or when the pump is in operation (control feature)

The distillation system is almost maintenance free. Depending upon weather conditions and dust in the air only the collector glazing has to be cleaned once in a while. Usually the glass only has to be cleaned once every several months.

Heavy dust coating reduces production by approx. 5 –10%.

7 P&I diagram



8 Wiring diagram

