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1. Information for the End User

This section provides the same content supplied in the owner's manual. As an installer please familiarise yourself with the content, as part of the installation process should be educating the consumer about how the system works, maintenance and safety considerations.

1.1. Understanding Water Heating

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

A water heater is traditionally an insulated metal tank full of water with an electric heating element or gas burner in the bottom. The water is heated to about 60°C-70°C depending on the thermostat setting. The average household of 4-5 people will use about 250-300L of hot water per day, which requires quite a lot of energy to heat, and that is why it is important to use solar to reduce the amount of electricity or gas used.

When you open the hot water tap, water pressure forces the hot water out. When this happens cold water is actually entering the bottom of the hot water storage tank, gradually pushing the hot water up and out. This can be seen in figure 1.1.2. Notice how the water is separated nicely into hot and cold layers. Because hot rises and cold sinks the water does not mix. This is referred to as stratification and is very important as it allows us to use nearly all of the hot water available in the tank. You can experience this when having a shower when the water suddenly turns cold; all of the hot has been drawn out.

In order to prevent scalding due to excessively hot water, most new houses have a tempering valve installed. If you are in an older house the plumber should advise that you install a tempering valve. This is an important safety device, as it limits the water supplied to the hot water taps to no more than 50°C. This temperature is quite hot, but will not cause burns.

The water generally leaves the hot water tank at 60°C-70°C. Then it passes through the tempering valve which brings the temperature down to 50°C by mixing with cold water. At the shower most people will then cool it down to around 42°-45°C by mixing with more cold water. This process is clearly shown in figure 1.1.3.

1.2. Solar Water Heating

This solar collector is a thermal solar heating device, quite different to photo-voltaic "PV" which converts the sun's energy into electricity. The operation is very simple - see figure 1.2.

Step 1. The evacuated tubes absorb sunlight and converts it into usable heat.

Step 2. The heat inside the evacuated tubes is transferred up into the insulated black box at the top of the tubes which contains a copper heat exchanger.

Step 3. An electronic controller measures the temperature of the solar collector and the water in the bottom of the storage tank. If the collector is hotter, meaning there is heat available, the controller supplies power to a circulation pump which pushes water through the collector heat exchanger and back to the storage tank.

Step 4. Throughout the day the circulation pump switches on and off gradually heating up the water in the tank.



FIG 1.1

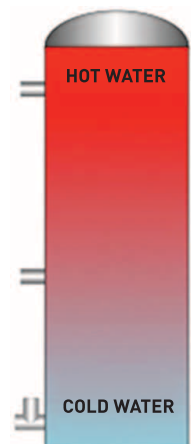


FIG 1.1.2

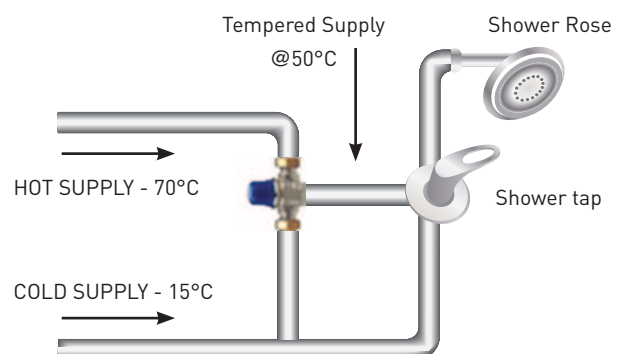


FIG 1.1.3

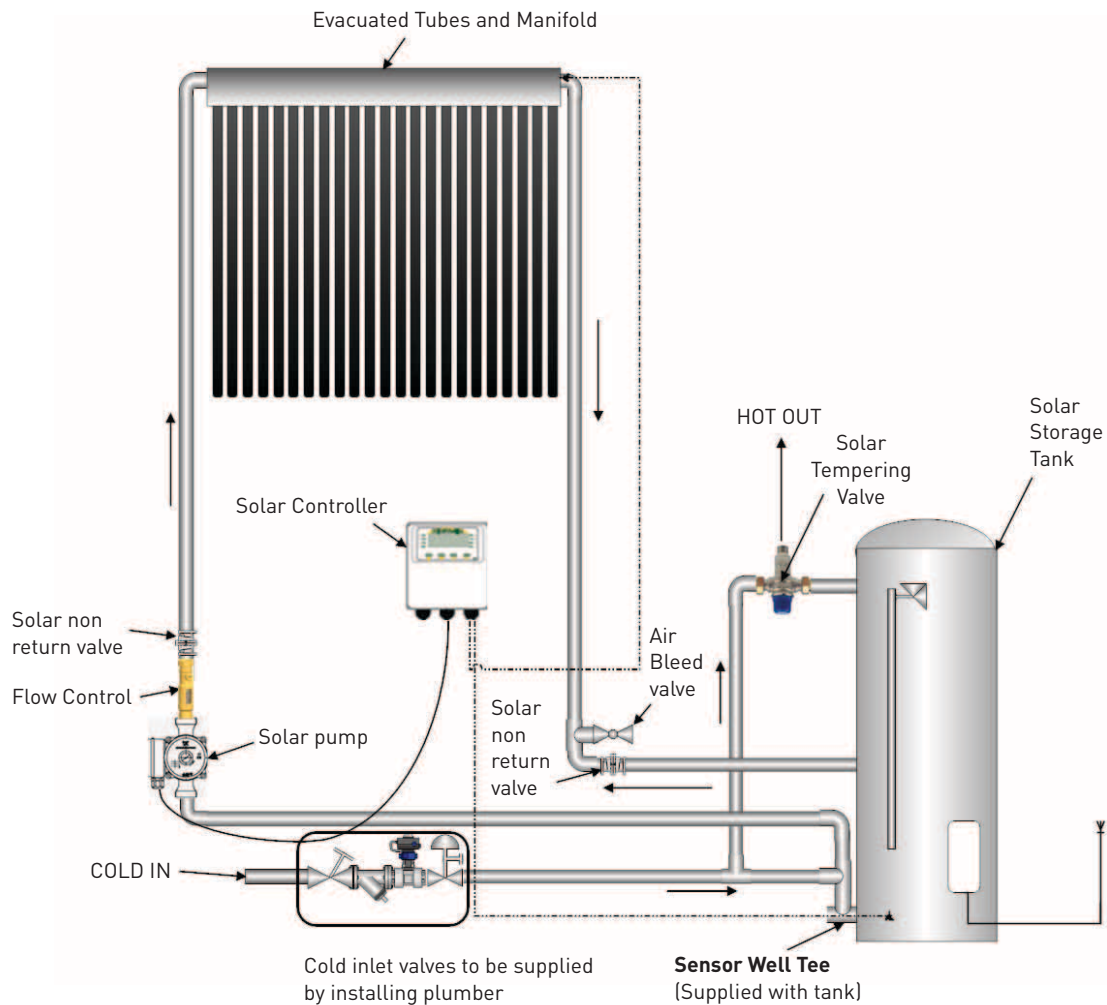


FIG. 1.2

1.3. How Does Boosting Work?

If the solar contribution during the day is not enough to raise the water to a suitable temperature an electric or gas booster can provide additional heating. During good sunny weather the solar collector will normally be able to provide enough hot water, but during winter months and overcast days boosting will be required. It is a legal requirement that the water be heated to 60°C on a regular basis to kill legionella bacteria that can lead to Legionnaires disease.

Bottom element electric boosted system
 = Once per week to 60°C

Mid element electric boosted systems
 = Once per day to 60°C

Gas boosted systems
 = each time water passes through the booster to 60°C

During good sunny warm weather the electric booster can often be turned off as the solar contribution will achieve 60°C in the tank, however during overcast or winter periods it is important that the booster is activated to meet the above requirements. Gas boosted systems should always be turned on.

Electric Boosted

If your system is electric boosted, when the electric element is activated it will heat up all the water above the element to 60°C (or the thermostat setting). This heating can take as long as 3-4 hours if the tank is cold, as the maximum output is limited to 3.6kW (15Amp).

Gas Boosted

Fig 1.3 show the operation for gas boosters that have internal controls for temperature regulation, in which case the booster only heats the water if it is less than 70°C. This "post boosting" method has the advantage

that you are not wasting gas keeping the tank hot and you have virtually unlimited hot water supply, unlike electric boosting which can run out.

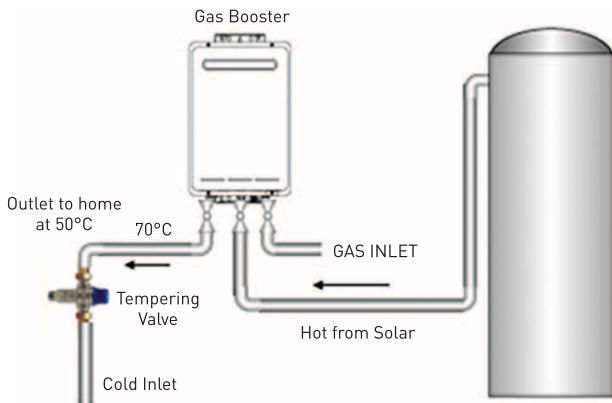


FIG. 1.3

1.4. Understanding Water Boiling

Solar collectors have the potential to heat water well above 100°C during periods of high solar radiation and minimal hot water usage. The system is designed to protect the tank by turning off the circulation pump when the storage tank temperature reaches around 70°C. Turning off the circulation pump will cause "stagnation" in the solar collectors which means that the amount of energy being absorbed equals the amount being radiated through heat loss to the surrounding air. During hot conditions the collectors can reach around 160°C. At this temperature the water does NOT boil, because it is under pressure. Because the pressure relief valve on the tank is set to 850kPa, the water would have to reach about 180°C before any steam formed which normally does not happen even on a hot summer day. If somebody in the house opens a hot water tap, the pressure in the system will drop to that of the incoming cold water. That is normally around 500-750kPa depending on the water supply and any pressure limiting valve that may be installed. Because the pressure drops there is the potential for some steam to form. This may result in some bubbling or crackling noises in the collector or tank. This is normal.

If in an area with lower than normal mains water pressure, or if using a pressure pump, a greater volume of steam may form. In some cases this may result in a louder noise in the tank due hot water from the collector mixing with the cold water entering the bottom of the tank. If this is of concern a combination of adjusting the controller setting, and some changes to the plumbing layout can help to reduce the noise. Please contact the company that installed the system for more information.

1.5. Electric Boosting Options

The end user may be happy to manually control the timer, turning it on when there is not enough hot water. This is OK if the operation of the system and hot water usage patterns are understood. There is also the option of an automatic timer fitted, which the plumber can fit allowing automated daily boosting.

Normally the automatic timer should be set to provide power to the element between 3-6pm ensuring a full tank of hot water for evening/morning showers. If the tank is already at 60°C the element will not turn on. If more hot water than normal is used there is the option of manually turning on the heating element via the ON/AUTO switch on the timer; it will take 3-4 hours to heat the tank up to a usable temperature. The element will then turn off. It is important the timer is switched back to AUTO, otherwise the element will keep turning on, wasting electricity.

If regularly running out of hot water an additional boosting period can be set. Technically competent end users may read the timer manual and change the settings, if not the plumber should be contacted to provide that service.

Please take note that in order for solar to be effective the tank should be at least half full of cold water in the morning. If a boost is completed at night without lots of morning hot water usage then the tank will be full of hot water and solar will not be effective, essentially "losing" that solar heat.

This can lead to the tank reaching maximum temperature by mid-morning, turning off the solar collector and wasting potential energy.

Example:

Problem: You use a lot of water in the evening and again in the morning. You are often running out of hot water in the morning.

Solution: Set two boost periods, one from 3-5pm in the afternoon, another from 4-6am in the morning. The afternoon boost period may need to be adjusted to 2-4pm if your day off-peak period is 10am-4pm, thus taking advantage of cheaper electricity rates.

1.6. Maintenance

PTR: It is recommended that the lever on the pressure and temperature relief valve (PTR) on the side of the hot water tank be operated once every 6 months to ensure reliable operation. It is important to raise and lower the lever gently, and be careful as the water released will be HOT.

Please note that hot water will be released from the drain pipe so please be careful. Ask your plumber to tell you where the valve is located if unsure.

GLASS BREAKAGE: If a severe storm occurs that causes flying debris, falling branches or massive hail it is possible that some of the tubes could be broken. The collector tubes are made of glass and so please take care to observe any broken glass that may have fallen off the roof.

This should be cleaned up and disposed of and the plumber called to come and check the system and replace any damaged tubes.

CLEANING: Regular rain should keep the evacuated tubes clean, but if particularly dirty they may be washed with a soft cloth and warm, soapy water or glass cleaning solution but **ONLY** if the solar collector is located in a position which does NOT require climbing onto the roof, use of stepladder or otherwise potentially dangerous location. If the tubes are not easily and safely accessible, high-pressure water spray is also effective.

If cleaning is required and the above outlined methods are not suitable, the company that supplied and installed the solar collector should be contacted to complete such cleaning.

LEAVES: During autumn, leaves may accumulate between or beneath the tubes. Please remove these leaves regularly to ensure optimal performance and to prevent a fire hazard. (The solar collector will not cause the ignition of flammable materials). Such cleaning may only be completed by the homeowner if the tubes are easily and safely accessible.

If cleaning is required and collector is not safely accessible the company that supplied and installed the solar collector should be contacted to complete such cleaning.

FREEZE PROTECTION: The solar system has a freeze protection feature built into the digital controller. If the temperature in the solar collector drops to around 2°C, the pump will be switched on to circulate some warmer water from the bottom of the tank through the lines to prevent freezing. The pump may come on several times throughout the night during cold conditions. If the pump is coming on more than once every hour, then additional insulation may be needed on the copper pipe runs.

1.7. Precautions and Warnings

VITREOUS ENAMEL TANKS: For solar collector systems using a vitreous enamel storage tank the following precaution applies:



IF THE HOT WATER SYSTEM IS NOT USED FOR TWO WEEKS OR MORE, A QUANTITY OF HIGHLY FLAMMABLE HYDROGEN GAS MAY ACCUMULATE IN THE WATER HEATER. TO DISSIPATE THIS GAS SAFELY, IT IS RECOMMENDED THAT A HOT TAP BE TURNED ON FOR SEVERAL MINUTES OR UNTIL DISCHARGE OF GAS CEASES. USE A SINK, BASIN, OR BATH OUTLET, BUT NOT A DISHWASHER, CLOTHES WASHER, OR OTHER APPLIANCE. DURING THIS PROCEDURE, THERE MUST BE NO SMOKING, OPEN FLAME, OR ANY ELECTRICAL APPLIANCE OPERATING NEARBY. IF HYDROGEN IS DISCHARGED THROUGH THE TAP, IT WILL PROBABLY MAKE AN UNUSUAL SOUND AS WITH AIR ESCAPING.

1.8. Warranty

ZEN solar water heating systems comprise components from a number of different suppliers. Pumps, tanks, controllers and gas boosters all carry their own manufacturer's warranty policies.

Please refer to the documentation provided with those products for complete warranty details.

The installer of the ZEN solar water heating system **MUST** provide you with 2 copies of the completed installation and warranty record form. In order to register your system for warranty purposes, please send to:

Fax: 08 8363 4110

Post to: 33 King Street, Norwood, South Australia 5067.

If the solar water heating system does not seem to be working properly or if you do not have any hot water during normal usage **DO NOT** attempt to inspect or repair your hot water system yourself. Call the plumber that installed the system or if they are unavailable call 1300 936 466.

Warranty Conditions

1. The solar water heating system must be installed in accordance with the manufacturer's installation instructions, the local authorities and all relevant statutory requirements - AS3500.4 & 5, AS5601, AS3000, AS2712 etc.
2. Installation may only be completed by plumbers, gas fitters and electricians that are licensed in the state the installation is completed.
3. This warranty applies only to those components provided as part of the ZEN solar water heating product and not any electrical or plumbing parts provided by the installer. E.g. Pressure limiting valve, duo-valve, etc.

4. The coverage period is valid from the date of installation. Should any part of the complete solar water heating system be replaced during the warranty period, the balance of the original warranty will continue to remain effective.
5. Should the system be installed in a region where regular flushing of the hot water tank is required to clean out sediment, a drain cock for flushing must be fitted at the time of installation. Please contact your plumber or local water authority if unsure if this is required.
6. The electrical system components are installed in a domestic application and connected to a 240V power supply by a qualified electrician in accordance with AS3000.
7. Component manufacturers are at liberty to alter the design or construction for the products not withstanding that the product may have been sold by description or sample, even though alterations may have been introduced for the date of Contract and the date of delivery provided that the products are of the same or similar quality and are fit for the purposes for which they are purchased. Such alterations shall not constitute a defect in design or construction under this Warranty.
8. Dated proof of purchase is required prior to commencement of warranty work.
9. The Warranty shall be limited to the replacement or repair, at the option of ZEN Energy of any defective products and of such parts as have been damaged in consequence of the defect. ZEN Energy is excluded to the extended allowable by Law from responsibility for consequential loss including:
 - Injury to persons
 - Damage to property
 - Economic loss
 - Pain and suffering; and
 - Any legal or other damages resulting from any manufacturing fault or defect.
10. ZEN Energy shall be under no obligation to return parts replaced at its option pursuant to this Warranty.
2. Where the solar collector leaks or fails to operate normally due to freezing in regions above the snow line and/or with minimum temperatures below -5°C (in accordance with AS/NZS 2712:2007 freeze level 1), or when power supply to the controller and pump is cut.
3. Damage to the collector due to excessive winds.
4. Damage to the evacuated tubes due to impact by any object.
5. The solar collector is left dry (no liquid circulation) and exposed to daily sunlight (I.e. not covered) for a period exceeding 14 consecutive days.
6. Failure of a vitreous enamel steel tank where the anode has been completely dissolved.
7. Where the solar water heating system component has failed directly or indirectly as a result of excessive water pressure, negative pressure (partial vacuum), excessive temperature, corrosive atmosphere, faulty plumbing and/or electrical wiring, or major variations in electrical energy supply.
8. Subject to any statutory provisions to the contrary, claims for damage to walls, foundations, gardens, etc. or any other consequential loss or inconvenience either directly or indirectly due to leakage from the solar water heating system or any other matter related to the system or its operation.
9. This warranty does not cover the effects of sludge/sediment as a result of connection to a water supply from suitably filtered or treated sources I.e. spring, dam, bore, river or town supply from a bore.
10. Where the water stored in the cylinder exceeds at any time the following levels:

Total hardness	200 mg/litre or p.p.m
Total dissolved solids	600 mg/litre or p.p.m
Electrical conductivity	850 µS/cm
Chloride	250 mg/litre or p.p.m
Magnesium	10 mg/litre or p.p.m
Sodium	150 mg/litre or p.p.m
pH	Min 6.5 to Max 8.5
11. Any serial tags/stickers on any of the components are removed or defaced.
12. The product is relocated from its original point of installation
13. Subject to statutory provisions to the contrary, ZEN Energy shall not be liable for consequential damage or any incidental expenses resulting from any breach of this warranty.

Warranty Exclusions

The following exclusions may cause the warranty to become void, and may incur a service charge and cost of parts that may be required.

1. Accidental damage, acts of God, failure due to misuse or incorrect installation, attempts to repair the system other than by a ZEN Energy accredited serviceman/technician.

14. The benefits conferred by this warranty are in addition to all other rights and remedies in respect of the product, which the purchaser has under the Trade Practices Act (Commonwealth) 1975, and similar State or Territory laws.

Warranty Coverage

Components that fail within the “parts and labour” warranted period due to faulty manufacturing or workmanship will be replaced at no charge to the customer within metropolitan areas. During the “parts only” warranty period only replacement product will be provided, with additional costs to be charged to the customer. Where the system is installed outside the boundaries of a Capital Cities Metropolitan area (I.e. those areas STD), the cost of transport, insurance and travelling between the nearest ZEN Energy accredited Service Agents premises will be charged to the owner. The period for which free replacement applies, varies for different components, as outlined.

ZEN Solar Collector: Copper heat transfer header

- One year parts and labour (All states)
- Ten years parts only (All states)

ZEN Solar Collector: Evacuated Tubes and Heat Pipes

- One year parts and labour (All states)
- Ten years parts only (All states)

ZEN Solar Collector: Mounting Frame

- Two years parts only (All states)
- Two year parts and labour (All states)

ZEN Solar Controller

- Two year parts and labour (All states)
- Five year parts only (VIC only)

ZEN Circulation Pump

- Two years parts and labour (All states)
- Five year parts only (VIC only)

ZEN Stainless Steel Tank (in case of rupture)

- One year parts and labour (All states)
- Ten years parts only (All states)

ZEN Solar Storage Tanks – Vitreous Enamel

- One year parts and labour (All states)
- Five year parts only (All States)

ZEN S-Series Gas Boosters

- Three years parts and labour (All states)
- Five year parts only (VIC only)
- Ten years only on heat exchanger (All states)

2. Important Information

2.1. Local Standards

- a) Installation must be completed in accordance with the requirements of AS/NZS 3500.4 (AS/NZS3500.4.2 “National Plumbing and Drainage Code Hot Water Supply Systems – Acceptable Solutions”), or in New Zealand, Clause G12 of the New Zealand Building Code, as well as any relevant local standards and regulations.

2.2. Authorised Person(s)

- a) Installation must be completed by a qualified trades person “installer”, who holds relevant industry licenses or certificates required for the work completed during the installation process.
- c) The term “authorised person(s)” or “installer” used throughout this document refers to a suitably qualified professional
- d) Unless otherwise specified in section 3, no part of the ZEN solar collector may be inspected, repaired or maintained by anybody other than authorised person(s).

2.3. Safety

- a) At all times installers must adhere to operational health and safety guidelines as outlined by Work Care and other relevant industry associations.
- b) At all times the installer is responsible for their own safety while completing installations.
- c) Under no circumstances should any person, qualified or otherwise, attempt to install a ZEN solar water heating system without thoroughly READING and UNDERSTANDING this installation manual. For any queries ZEN Energy staff may be contacted.

2.4. Pressure and Temperature Control and Relief

- a) Where the mains pressure supply can exceed or fluctuate beyond the pressure of 750kPa, a pressure limiting device (complying with AS 1357) must be fitted to the cold water inlet supply. This device must be installed after the isolation valve and set at or below 750kPa.

NOTE: In WA and SA, it is a requirement that a pressure relief valve be fitted on the cold water supply line between the non-return valve and water heater. A separate drain line must be run for this relief valve. It is not permitted to couple drain lines from relief valves into a single common drain.

- b) Any system design must provide means for allowing pressure release at no more than 850kPa, using a pressure and temperature relief valve (PTR).

From time to time the PTR may discharge a small amount of water, this is normal. The PTR must have a downward direction copper pipe connected that is open to the atmosphere, running the expelled hot water or air to a safe, frost free and appropriate drainage location.

THE RELIEF VALVE OR DRAIN TUBE MUST NOT BE SEALED OR BLOCKED.

- c) It is recommended that the lever on pressure and temperature relief valves be operated once every 6 months to ensure reliable operation. It is important to raise and lower the lever gently, and be careful as the water released will be HOT.
- d) If installed inside a building, a safe-tray must be installed beneath the hot water tank to safely collect any water expelled from the pressure and temperature relief valve.
- e) For glass lined/enamel lined tanks the electric thermostat setting (if applicable) and maximum tank temperature in the solar controller must be set to no more than 70°C, or as specified by the tank manufacturer.

2.5. Water Quality

- a) Water used in the system must meet the following requirements. This is extremely important for stainless steel tanks which are more susceptible to damage from poor quality water. If in doubt contact your local water authority or have a water test completed.

Total dissolved solids < 600 mg/L or ppm
Total hardness < 200 mg/L or ppm
Chloride < 250 mg/L or ppm
pH < Min 6.5 to Max 8.5
Magnesium < 10 mg/L or ppm
Sodium < 150 mg/L or ppm

- b) In areas with “hard” water (< 200mg/L or ppm), it is advisable to install a water softening device to ensure the long term efficient operation of the collector, and to avoid voiding the collector and tank warranty.
- c) If using a glycol/water mix, the water must meet the above requirements, and the glycol content of the liquid must not exceed 50%, unless the manufacture specifies that a different ratio is recommended for use with solar water heaters. Glycol may need to be changed periodically (every 3-5 years) to prevent the glycol from becoming acidic; please refer to the guidelines provided by the glycol manufacturer regarding replacement times.

- d) In order to meet health and safety regulations, only food heat transfer fluids should be used.

2.6. Legionella

- a) In order to kill Legionella bacteria it is an Australian standards requirement (AS3498-2009) that the hot water in the storage tank be heated up to at least 60°C on a regular basis, either while in the storage tank (solar/ electric) or by a post boost (gas continuous flow). Please educate the home owner to ensure they adhere to the following guidelines:

Bottom element electric: Tank must reach 60°C at least once a week. The element should be activated at least once weekly during winter months and overcast weather.

Gas boosted systems: Gas booster must be left on at all times. It will only boost the water if it is less than 70°C.

2.7. Metallic Corrosion

- a) Both copper & stainless steel are susceptible to corrosion when, amongst other factors, high concentrations of chloride are present. The solar collector may be used for heating of spa or pool water, but levels of free chlorine must not exceed 5ppm, otherwise the copper header could be corroded.
- b) ZEN Energy does not warrant the solar collector against corrosion related damage.

2.8. Freeze protection

The solar collector is not suitable for frost-prone areas unless protected by a frost protection system or device.

- a) For all ZEN Energy systems listed in Appendix C-E freeze protection is provided by the delta-t controller which will circulate the pump if the collector temperature approaches freezing. This freeze protection method has passed to frost level 2 (-15°C) in line with AS/NZS2712:2007 requirements. In areas with unreliable power supply a UPS (uninterrupted power supply) unit may be used to ensure power to the controller and pump during power outages.
- b) For areas with sustained winter temperatures below -5°C, a closed loop filled with an anti-freeze heat transfer fluid should be used to provide freeze protection. Please refer to heat transfer liquid manufacturer's specifications about the temperature ranges the liquid can withstand. Only food grade heat transfer fluids should be used.
- c) Evacuated tubes are not susceptible to damage in cold weather, and ZEN copper heat pipes are

protected against damage that could result from the freezing of the water inside.

- d) ZEN Energy does not warrant the solar collector against freeze related damage.

2.9. Collector Dimensions & Weights

Collector Size	20 Tube HP	32 Tube HP
No. of Tubes	20	32
Tube Length	1800mm	1800mm
Overall Height	1960mm	1960mm
Overall Width	1530mm	2394mm
Overall Depth	150mm	150mm
Absorber Area	1.6m ²	2.57m ²
Aperture Area	2.0 m ²	3.2 m ²
Gross Area	2.99m ²	4.69m ²
Installation Angle	20° - 70°	20° - 70°
Dry Weight	76 kg	118kg

2.10. Roof Structural Integrity

- a) Collector weight is minimal and will not cause excessive weight stress on the roof structure. No reinforcement of the roof structure is needed for flush mounted collectors.
- b) If installing at a raised angle (angle frame) in a high wind region, high winds will cause vertical and horizontal loads on the frame. Please ensure that the frame structure is able to withstand such forces. Contact your local building department if in doubt.

2.11. Vitreous Enamel Tanks with Sacrificial Anode Fitted

For solar collector systems using a vitreous enamel storage tank:



IF THE HOT WATER SYSTEM IS NOT USED FOR TWO WEEKS OR MORE, A QUANTITY OF HIGHLY FLAMMABLE HYDROGEN GAS MAY ACCUMULATE IN THE WATER HEATER. TO DISSIPATE THIS GAS SAFELY, IT IS RECOMMENDED THAT A HOT TAP BE TURNED ON FOR SEVERAL MINUTES OR UNTIL DISCHARGE OF GAS CEASES. USE A SINK, BASIN, OR BATH OUTLET, BUT NOT A DISHWASHER, CLOTHES WASHER, OR OTHER APPLIANCE. DURING THIS PROCEDURE, THERE MUST BE NO SMOKING, OPEN FLAME, OR ANY ELECTRICAL APPLIANCE OPERATING NEARBY. IF HYDROGEN IS DISCHARGED THROUGH THE TAP, IT WILL PROBABLY MAKE AN UNUSUAL SOUND AS WITH AIR ESCAPING.

2.12. Draining Hot Water Tank

In the event that the hot water tank needs to be serviced, relocated or replaced it must first be drained. To drain the tank:

WARNING: BEWARE OF HIGH TEMPERATURE WATER.

- Disconnect all power supply to water heater (for electric boosted tanks).
- Turn off the mains cold water supply.
- Release the pressure in tank by carefully operating the PTR valve release lever/knob.*
- Undo the cold water inlet union. Attach a hose to the heater side of the union. Drain the hose to waste.
- Operate the PTR valve release lever/knob allowing air into the heater and water to drain via the hose.
- To fill the hot water tank refer to 3.8.4.

2.13. Setting Electric Boosted Tank Thermostat

- Electrical connections must only be completed by a qualified electrician.
- The thermostat is generally factory set to between 60°C and 70°C. Under no Circumstances should the setting be reduced below 60°C. Changes to the thermostat setting may only be completed by a qualified electrician.
- To adjust the temperature setting:
 - Disconnect the electrical power supply to the tank.
 - Remove the element cover.
 - Using a small screw driver, rotate the thermostat to the desired temperature.

2.14. Setting Gas Booster Temperature

ZEN S20, S26 & Enviro 26

- The ZEN booster is pre-set to 70°C and does not need to be adjusted.

2.15. Installation Preparation

- Always check components before travelling to installation site. In particular check to ensure all evacuated tubes are in good condition.
- Always take spares of key components such as evacuated tubes, fittings, sensor cables etc.
- Ensure any required tools and safety equipment are taken to the installation site.
- Ensure a copy of this installation manual is kept in the vehicle for reference.
- Always take a digital camera to take photos of the completed installation.

2.16. Water Boiling Temperature

It is important to understand the properties of water when dealing with any hot water system that operates under pressure. The solar collector has the potential to reach temperatures above 100°C during high solar radiation level once the tank has reached temperature at the pump has been switched off. The table below shows that at 811kPa, which is close to the opening pressure of the PTRV, the boiling temperature of water is 170°C.

Pressure - kPa	Boiling Point - °C
101	100
203	120
304	133
405	143
507	151
608	158
709	164
811	170

2.17. Scope of Manual

- This manual pertains only to the installation and operation of the ZEN solar collector. Details for the installation, operation and maintenance of the complete solar gas/electric water heating system including, but not limited to storage tank, gas/electric booster, pump, system controller, valves and other plumbing components should be provided separately by their respective manufacturers.
- This manual is primarily a reference document for installers, as the solar collector is not permitted to be installed by non-authorised persons.

2.18. Terminology

The terminology used from region to region differs and so to avoid confusion please note the following terminology.

- Return: indicates the plumbing line running from the outlet of the collector back to the tank.
- Flow or Supply: indicates the plumbing line running from the tank (or heat exchanger) to the inlet of the collector. This line incorporates the circulation pump.
- Insolation: solar radiation level, expressed in kWh/m²/day
- PTR: pressure temperature relief valve, installed on the hot water storage tank to relieve pressure, and excessive temperatures.
- Header: is the copper heat exchanger pipe in the solar collector through which the water flows.

3. Solar Collector Installation

3.1. Transport, Unpacking and Inspection

3.1.1. Transport

- a) When possible transport the boxes of evacuated tubes standing upright, taking notice of the "THIS WAY UP" arrows. If the boxes can only be laid down, always place on a flat, firm surface such as a compressed wooden board. If stacking the boxes, ideally do not exceed 3 layers, and ensure they are strapped down in place to avoid movement. Straps should be padded with thick cardboard or similar at box corners to avoid cutting into the boxes.

3.1.2. Component List

- a) Please familiarize yourself with the components listed on the packing list, which is included in the collector manifold packing box. If any components are missing, or additional parts are required, please contact your supplier who will have spares in stock.

3.1.2. Tube & Heat Pipe Inspection

- a) Open tube box(s), which contain the evacuated tubes with heat pipes inserted. Check to make sure the evacuated tubes are all intact, and the bottom of each tube is still silver. If a tube has a white or clear bottom, it is damaged and should be replaced. The heat pipe should be removed and inserted into a replacement tube.
- b) Heat pipes are bright and shiny when newly manufactured, but will dull and may form dark-grey surface discolouration over time. This is due to mild surface oxidation (when exposed to air) and is perfectly normal and does not affect the integrity of the heat pipe.

- c) Do not remove and/or expose the tubes to sunlight until ready to install, otherwise the heat pipe tip will become very hot, sufficient to cause serious skin burns. The outer glass surface will not become hot. NEVER TOUCH THE INSIDE OF THE EVACUATED TUBE OR HEAT PIPE TIP AFTER EXPOSURE TO SUNLIGHT. WEAR THICK LEATHER GLOVES IF HANDLING THE HEAT PIPE.
- d) WEAR SAFETY GLASSES AT ALL TIMES WHEN HANDLING THE GLASS TUBES.
- e) ZEN Energy does not warrant the tube or heat pipes against failure as a result of damage incurred during transport or installation.

3.1.3. Frame

- a) Unpack the standard frame that is provided together with the manifold. If a frame kit is being used, those components will be packed separately from the manifold. See Appendix A for standard frame diagram.
- b) Depending on the roof surface, rubber pads, roof attachment straps or round feet may be used to attach the standard frame to the roof. These components are supplied separately from the standard frame.

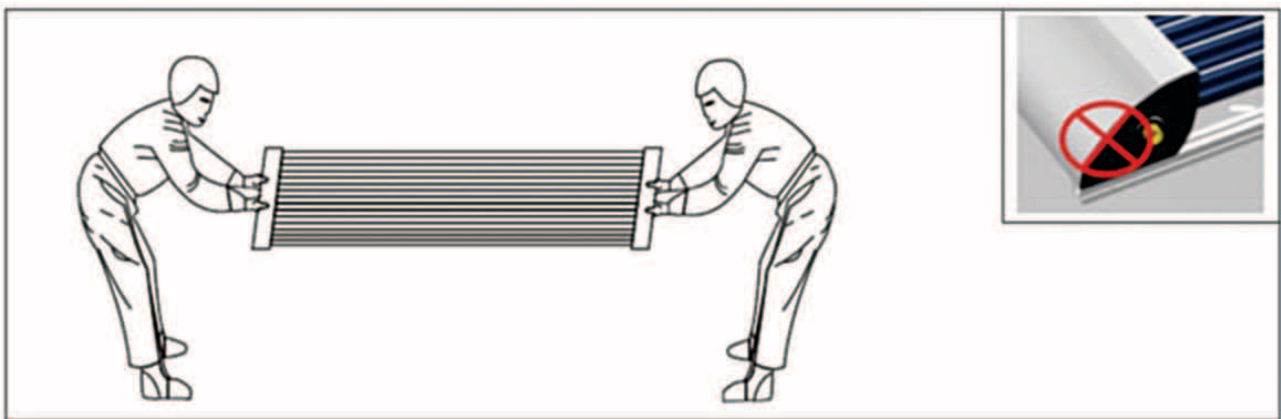


FIG. 3.1.1

3.2. System Design

3.2.1. Custom System Design

- a) For commercial or other nonstandard installations, the system design should be completed prior to commencing installation. Solar collectors need to be installed correctly to ensure high efficiency, and most importantly, safe and reliable operation. Please seek professional advice for the design and installation of the solar heating system. Only installers are permitted to install the solar collector. ZEN Energy does not provide warranty coverage and will not be held liable for any damage to person or property that results from solar collectors that are installed by un-authorised persons. In addition, all system components must meet relevant Australian Standard, in particular Watermark for any component in contact with potable water.

3.2.2. Delta-T Controller Settings

- a) Usually a Delta-T ON value of 8°C and Delta-T OFF value of 2°C is suitable. These settings may need to be altered slightly according to the location and system design. Setting the Delta-T OFF value too high runs the risk of the pump coming on and off too frequently, shunting batches of hot water back down the line, but not necessarily running for long enough for that hot water to reach the tank. The result is the hot water cools in the lines before reaching the tank, reducing heat input. Ideally when there is good sunlight the pump should run continually, and so a suitable Delta-T OFF setting will allow this.

3.2.3. Stagnation and Overheating

- a) Stagnation refers to the condition that occurs when the pump stops running, due to pump failure, power blackout, or as a result of a high tank temperature protection feature built into the controller, which turns the pump off.
- b) If the system is designed to allow stagnation as a means of preventing tank overheating, the collector and plumbing in close proximity may reach temperatures of up to 170°C; therefore components that may be exposed to the high temperatures such as valves, plumbing or insulation, should be suitably rated.
- c) If the system is designed to allow stagnation of the collector when the tank reaches a set maximum level, steam may form in the header (depending on the system pressure). In such a system, a temperature relief valve should NOT be installed on the collector outlet, as it will dump hot water,

which is not allowed. Auto air vents can help to relieve steam formation, but must be rated to at least 200°C. In addition; air vents are highly susceptible to blockage over time due to scale formation in areas with hard water.

The system designs listed in Appendix B through E meet the NO-LOAD system requirements of AS/NZS 2712:2007 and will not dump large volumes of water from the PTRV. They are designed to allow stagnation by means of turning off the circulation pump once the tank reaches a target maximum temperatures as measured by the controller.

- d) When the storage tank temperature is up to 70°C in the bottom of the tank, cold water entering the tank when hot water is used can causing gurgling noises. This is normal but can be greatly reduced by forming a heat trap in the copper pipe on the solar return line, just before the tank. The downward U shaped heat trap should be at least 20cm tall.

3.2.4. Correct System Sizing to Avoid Overheating

- a) For custom system designs, the system should be sized so that overheating of the tank is difficult to achieve in a single day, even during hot, sunny periods. If the system is over-sized, such that excessive heat is often produced during summer months, then excessive heat can be used to heat a spa or pool; see also 3.2.6.

3.2.5. Solar for Central Heating – Preventing Overheating

- a) If a system has been designed to provide contribution to central heating, it will often provide much more heat in the summer than is required for hot water supply alone. In such cases it is advisable for the home to have a spa or pool that can use the heat in the summer period. See also the following point (3.2.6), regarding reduction of summer heat output.

3.2.6. Adjusting Collector Angle to Ease Overheating

- a) Apart from installing a smaller collector, a good method of reducing summer heat output is to angle the collector for optimal winter sun exposure. This is achieved by installing the collector at an angle of around 15°–20° above the latitude angle. This angle corresponds closely to angle of the sun in the sky during the winter months, thus maximizing winter output. Conversely, during the summer when the sun is high in the sky, the relative surface area of the collector exposed to sunlight is reduced, in effect reducing overall heat production considerably (by about 20%). This option is ideal for installations

where solar thermal is being used for space heating. A wall mounted collector with overhanging eaves above is also an excellent design for large systems, ensuring optimal winter output and shading the collector partially during summer periods.

3.2.7. Collector Direction

- a) The collector should face the equator, which in Australia and New Zealand (Southern hemisphere) is due North. Facing the collector in the correct direction and at the correct angle is important to ensure optimal heat output from the collector, however a deviation of up to 15° east or west of due north is acceptable, and will have minimal effect on heat output. If installed due east or west, the solar collector output will be considerably reduced, with predominately morning output or afternoon output for each direction respectively. If, however, the collector is installed pointing east or west on a low pitched or flat roof, by raising the angle of the collector to 50°-60° the underside of the tubes can be exposed to sunlight, increasing the total day output to a closer level to if pointing north.

3.2.8. Collector Plane

- a) The collector manifold is normally installed on the flat horizontal plane, but may be installed at an angle of +/-60° from horizontal as may occur if installing on the side of an east or west facing pitched roof.
- b) The collector must not be installed up-side-down (tubes pointing upwards) or with tubes lying horizontally, as the heat pipes will not function properly.

3.2.9. Collector Angle

- a) It is common for collectors to be installed at an angle that corresponds to the latitude of the location. While adhering to this guideline, an angle of latitude +/- 10° is acceptable, and will not greatly reduce solar output. See also point 3.2.6.
- b) The solar collector should be installed at an angle of between 20-80° to ensure optimal operation. Vertical installation is acceptable, but the heat output may be reduced somewhat due to less optimal heat pipe operation.

Flat installation is not acceptable. In most installations it is highly recommended to achieve an install angle of 45-50°. This provides optimal winter output, and greatly increases resistance to freak hail storms. See also point 3.2.6.

3.2.10. Avoid Shade

- a) Collectors should be located so that shading does not occur for at least the 3 hours either side of 12 noon local time.
- b) Partial shading due to small objects such as antennas and small flues is not of great concern.

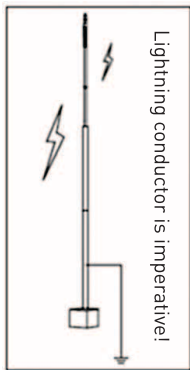
3.2.11. Location

- a) The collector should be positioned as close as possible to the storage cylinder to avoid long pipe runs. Storage cylinder positioning should therefore consider the location requirements of the solar collector.
- b) The storage cylinder should be located as close as possible to the most frequent draw off points in the building. If the storage cylinder is located a long way from hot water draw points a hot water circulation loop on a timer may be considered to reduce the time-lag for hot water, and resultant water wastage.

3.2.12. Expansion Vessel/Tank

- a) In any hot water system, be it solar, gas, electric or combination thereof, expansion of water will occur as the water heats up. When water expands it has to be controlled, as it cannot be compressed like air.
- b) In mains pressure open loop systems that have a check valve/non-return valve on the cold mains, this water is released via the pressure release valve, which is installed on the storage tank.
- c) Closed loop systems using an anti-freeze heat transfer fluid should always be installed with an expansion vessel as the liquid should not be dumped from the system. The expansion vessel will accept the increase in liquid volume and prevent excessive pressure levels. For domestic applications using 30-90 tubes, a 10-12L expansion vessel should be used. Refer to the expansion vessel manufacturers' guidelines regarding correct sizing for larger applications.

3.2.13. Lightning Protection



- a) If the installation location is prone to lightning strikes, it is advisable to earth/ground the copper circulation loop of the collector to avoid lightning related damage, or electrical safety issues. Refer also to local building codes regarding lightning safety and grounding. Fig. 3.2.8

FIG. 3.2.8

3.2.14. Pipe Connections & Pipe Size

- a) ZEN solar collectors are provided with a standard 20mm brass male thread for direct connection. This male thread is for use with a female elbow and is NOT a compression fitting. The fitting body can be changed to a 3/4MI / 20MI union body if connecting multiple collectors for commercial applications. Only Australian standards approved DZR brass fittings may be used.
- b) For domestic heating applications with 1 or 2 collectors, nominal DN15 / 1/2" copper piping is suitable.
- c) For applications using 2 or more solar collectors in series, or with a pipe run longer than 40m it is advisable to use a nominal DN18 / 3/4" piping.
- d) For connection of banks of collectors, larger pipe sizes should be used as specified for the given application, with consideration made to flow rates, pressure drop and pump sizing.
- e) The material used for the solar loop must be able to withstand the operating temperatures and pressures to which the system may be exposed, due both normal and extraordinary conditions (E.g. Pump failure, or power outage). Copper pipe is the most widely used piping material for solar applications. Synthetic piping should not be used for the solar loop, unless specifically rated for high temperatures (>180°C), and even then should not be connected directly to the collector, but rather an intermediate 50+cm length of copper pipe should first be used.

3.2.15. Connection of Multiple Collectors

- a) When connecting collectors in series that have end manifold connections (as opposed to rear), flexible connections should be used between each collector in order to allow for the expansion and contraction of the copper header with temperature changes. Failure to use flexible connections between consecutive

collectors may result in damage to the header if the system stagnates.

- b) ZEN Energy does not warrant the collector against damage resulting from poorly managed header expansion and contraction.

3.2.16. Heat Transfer Liquid

- a) In regions where freeze protection is not a concern, water is the most appropriate heat transfer fluid.
- b) If the system is direct flow, meaning that potable water is flowing through the collector, any components used in the system must meet potable water requirements (Watermark approval).
- c) When using a direct flow system in an area with hard water (high mineral content), scale may gradually form in the solar collector loop, reducing performance, increasing pressure drop, and ultimately rendering the system inoperable (due to flow restriction). In such regions, a water treatment system should be installed, which either removes the scale forming minerals, or prevents formation of a scale layer.
- d) In regions where freeze protection is required, it is advisable to use a closed loop system with a food grade heat transfer fluid (normally propylene glycol). This liquid should be used directly, or mixed with water as per the manufactures instructions.

If using a non-food grade heat transfer fluid, check with local authorities about regulations regarding the use of single or double wall heat exchangers with such liquids.

3.2.17. Delayed Installation or Use

- a) If the manifold is to be installed days or weeks prior to tube installation please note the following:
 - i) Cover the manifold with a durable, waterproof cover to prevent water ingress, or access to insects or birds.
 - ii) DO NOT leave the manifold without tubes installed during periods of likely snowfall, as there is a high probability of snow entering the manifold ports and causing water damage to the Polyurethane.
- b) The collector should not be installed fully and left sitting dry (no fluid circulation) for more than 14 days - to do so will void the warranty as it could affect heat pipes or tube longevity. If to be left for a long period of time the tubes should not be installed (see above point), or the collector should be covered.

3.3. Mounting Frame

ZEN solar collectors are supplied with a standard frame, which is suitable for flush mounting on a suitably

pitched roof. For installation on insufficient pitched roofs, flat roofs or off walls, additional frame kits are available.

Depending on the roof surface, the standard frame may be attached to the roof with rubber pads, roof attachment straps, or round feet.

3.3.1. Frame Material

- a) All frame components are made of aluminium making the frame both strong and corrosion resistant. It is important that frame attachment points and externally supplied fasteners are also of suitable structural strength.
- b) Tighten frame bolts with supplied spanner or short shafted socket wrench only. DO NOT use power tools or long shafted tools that may over-torque the bolt.

Bolt assemblies include a spring washer to maintain good long term tension with heat expansion and contraction.

3.3.2. Galvanic Reaction between SS and Zinc Galvanised Steel

- a) Zinc galvanized components should NOT be installed in direct contact with stainless steel, as galvanic reaction between the two metals can cause premature oxidation of the zinc coating and rusting of the steel underneath. Zincalume roofing material is not as susceptible to the same reaction, however a rubber pad should always be used to avoid scratching of the roofing material.
- b) Avoid using galvanized steel bolts; instead use stainless steel components.

If galvanized components are used, avoid direct contact between the two metals by using the rubber/ plastic separators, such as the ZEN rubber frame pad.

3.3.3. Manifold and Bottom Track Attachment

Step 1. Lay the left and right frames opposite on the ground as shown in the right figure. (Image: SFA1)

Step 2. Bolt the frames to the header and the tube bottom rack. (Each set of fittings includes one bolt, one nut, one washer and one spring washer.) (Image: SFA2)

Step 3. Bolt two braces to the frames and the header and another two braces to the frames and the tube bottom rack. Tighten all the fittings. (Image: SFA3)

Step 4. Attach the stainless steel strap (supplied) to the top of the manifold frame leaving 500mm from the top edge of the manifold

Step 5. Position the frame on to the roof. For iron roofs position the stainless steel tails from the manifold frame and secure to existing roofing screws. For tiled

roofs, remove selected tiles and secure the stainless straps back to rafters using roofing screws

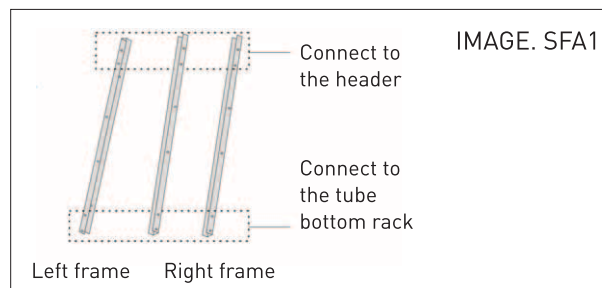


IMAGE. SFA1

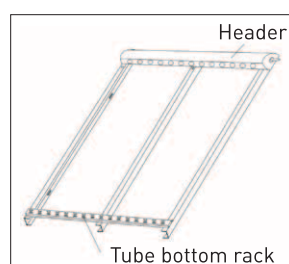


IMAGE. SFA2

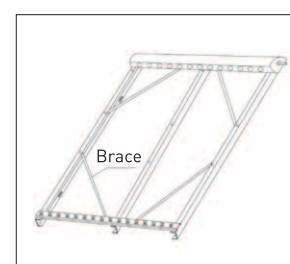


IMAGE. SFA3

3.3.4. Customising the Frame

- a) The standard frame, flat roof frame components can be used creatively to suit a range of different installation surfaces. Additional holes (no larger than Ø10mm diameter) may be drilled in the frame as required, but the frames structural integrity must not be compromised (DO NOT drill holes closer than 30mm centre to centre).

3.4. Installation Planning

- a) For tiled roofs, carefully plan the location of the manifold, frame front tracks and plumbing pipes in order to minimize the number of tiles that need to be removed (and returned into place). Tiles may have holes cut to allow the roof straps or bolts to pass through. Any holes must be covered and/or sealed with standard roofing materials/sealants to avoid leaks.

3.4.1. Positioning Manifold

- a) Lay the collector flatly on the support frame, hook the groove underside manifold case to hang the collector on two frames, adjust the collector to get an even clearance between two support frames.

Note: Do not install vacuum tube now.

3.4.2. Connection of hot pipe from Manifold

- a) When connecting the return hot water from manifold to the solar tank, there **MUST** be the inclusion of a solar non return valve and bleed valve, this will allow full flow through the manifold thus forcing all the air from the highest point on the solar system. (Ref: Fig 1.1.2)
- b) When a steady stream of water flows from the bleed valve, this can then be isolated and secured.

3.4.3. Tiled Roof Attachment

- a) For flush mounting on tiled roofs, roof attachment straps can be used; 2 per front track. One end of each strap should be secured to the underside of the frame front tracks using the supplied M8-20 bolts and nut lock assemblies, the other end to the roof rafter using 2 x Ø6x75mm stainless steel batten screws. Once the upper straps are attached and tightened, adjust the bottom straps to ensure that they too are providing support to the frame.
- b) In high wind areas roof attachment straps should **NOT** be used, instead direct bolting through the tiles into the roof frame is recommended. Care should be taken when drilling a hole in the tiles to avoid breakage.

3.4.4. Corrugated Steel Roof

- a) For installation on a corrugated steel roof, rubber pads can be used to separate the frame from the roof and also to seal the hole. It will bend to match the shape of the ridge. Never install in the valleys..
- b) Where possible only use stainless steel screws. Direct contact between the screw and the roofing material should be avoided to prevent galvanic reaction and therefore a →10mm diameter hole should be drilled.
- c) If the roofing screw is galvanized steel, direct contact between the screw and the frame must be avoided by use of a nylon or rubber washer. Many roofing screws come with a washer already in place.
- d) Cover the bottom side of the rubber pad with a layer of outdoor grade silicone sealant to ensure a waterproof seal where the roof is formed. Also put a small amount of silicone sealant on the thread of the screw to form a waterproof seal with the rubber pad hole.
- e) This mounting method is also suitable when attaching the roof tracks used in the low, mid or high angle frame kits when using the roof track option. (See section 3.5 & 3.6)

3.4.5. Correctly Align Frame

- a) Ensure that the front tracks are both parallel and level before attaching the manifold or bottom track. Using the horizontal braces supplied with the standard frame will ensure the front tracks are parallel. An uneven or non-parallel frame may result in damage to the system, in particular, the evacuated tubes.

3.5. Flat Roof Installation (Angle Frame)

Refer to Appendix B for assembly diagram. The high angle frame is appropriate for installations on flat surfaces. The high angle frame kit combines with the standard frame components to form the complete frame assembly. Refer to Appendix B for assembly diagram.

3.6. Connection to Plumbing

3.6.1. Plumbing Connection

- a) Once the frame has been mounted and the manifold attached, the manifold header may be connected to the system plumbing.
- b) Evacuated tubes and heat pipes should only be installed after connection to the tank and flooding of the system has occurred. Flooding a hot dry solar collector will generate large volumes of super-hot steam and could be dangerous.

3.6.2. Temperature Sensor Insertion

- a) The temperature sensor port on the solar collector is located beside the inlet and outlet ports. The temperature should be sensed at the outlet of the manifold, which is the higher of the two ports. Fig 3.8.7
- b) The solar controllers temperature sensor should be coated with a thin layer of thermal paste and inserted into the sensor port to the full depth. If the fit is too loose, slide a piece of copper or stainless steel plate/ wire in beside the sensor.
- c) Ensure that the insulation tightly covers the opening to prevent water ingress. Use a silicone sealant if required to ensure a watertight seal against the manifold.
- d) Ensure that sensors used on the collector are high temperature rated (up to 180°C), in particular the cable which should ideally be silicone rubber.
- e) Do not run the sensor underneath the insulation alongside the copper pipe, as high temperatures can melt the cable. Instead run along the outside of the

insulation, securing in place every 15-20cm with UV resistant nylon cable ties.

3.6.3. Collector header connection

- a) Both the inlet and outlet of the header are externally threaded (20mm).

Note: Connect the collectors with Copper pipes rather than plastic pipes, given their high temperature and pressure resistance.

i) ZEN Energy will not be held responsible for damage to the collector resulting from flame/heat related damage.

- b) Hold the header inlet/ outlet with a wrench before connecting the connectors. See Fig. 3.8.7

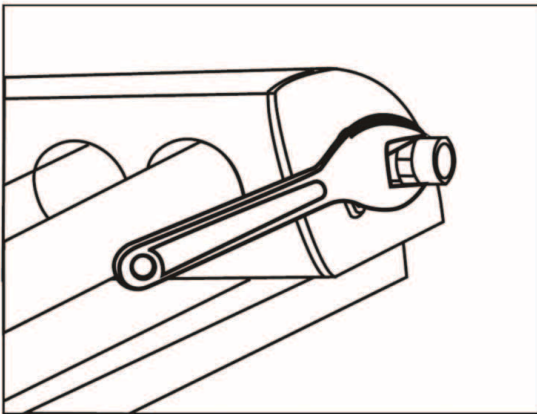


FIG. 3.8.7

3.6.4. System Filling & Air Purge

Once the inlet and outlet are connected to the plumbing system, the hot water tank should be filled with water and the collector loop should be purged of air. This should be completed before the evacuated tubes are installed.

- a) To fill the tank, open the cold water supply to the tank. Gently operate the level/knob on the PTRV to allow air to be released so the tank can fill. Close the PTRV once water is expelled.
- b) Mains Pressure Open Loop – for a system without an auto-air vent installed, open the isolation valve installed on the hot water return from the solar manifold, this will purge all air from the highest point of the solar circuit, leave isolation valve open for up to 60 seconds to ensure all air has been removed. Operate the PTR again to release any air in the top of the tank.

3.6.6. Plumbing Check

- a) Once plumbing is confirmed as leak free and with the correct flow rate, the heat pipes and evacuated tubes may be installed.

3.6.7. Insulation

- a) Heavily insulate all piping running to and from the manifold with a high quality insulation of at least 15mm thickness, or 25mm in cold climates. Heat loss from the piping can be significant, and so particular attention should be taken to insulate any possible points of heat loss.
- b) Ensure the insulation is tight against the manifold casing, thus minimising loss of heat from the inlet and outlet. In order to prevent water from entering the temperature probe port and/or in-between the piping and insulation foam, a high quality silicone sealant should be used to form a water-tight seal.
- c) Insulation foam that is exposed to direct sunlight should be protected against UV related degradation by wrapping/covering with a suitable material such as adhesive back aluminium foil, PVC conduit or similar.
- d) All internal piping as well as external should be insulated. This includes at least the 1m of piping closest to the hot water outlet of the tank, as this copper pipe is a significant point of passive heat losses.

3.6.8. Pump Selection

- a) The pump should provide enough pressure to enable circulation through the collector header at a set flow rate which ensures optimal heat transfer and minimises turbulence in the storage tank. For installations of a single collector (32 tubes) with the installation of the Flow Regulator (Image. Flow 1.1) a nominal flow rate of .75L/min per m² is generally suitable and can be adjusted to suit using a bladed screw driver
- b) For more than 32 tubes: Flow rate = # tube x 0.1L/min. E.g. 180 tubes = 18L/min. This is based on a 7°C temperature rise during peak solar radiation levels. If a higher temp rise is required the flow rate can be decreased accordingly.
- c) If the water pressure used in the solar loop is sufficient to fill the header passively,



IMAGE. Flow 1.1

then the pump is simply required to circulate the water. The key consideration is therefore the pressure drop throughout the pipeline. Elbows, tees, and bends in piping all contribute to pressure drop. Pressure drop through a ZEN 32 tube header at 3L/min and 20°C is around 0.8kPa. Pressure drops at higher temperatures will be slightly lower.

- d) For single storey/floor houses where the pipe run to and from the collector is no more than about 12m, a small 33 Watt pump with low head pressure (1m head / 10 kPa) may be sufficient. Two or three storey houses where the pump run is longer, a 70Watt pump may be required. The use of a 3 speed pump is ideal, as an appropriate speed setting can easily be chosen (i.e. 40, 60 & 90Watt settings).

e) Checking pump operation:

- i) After initial installation of collector, watch the operation of the pump and controller for at least 5 ON/OFF cycles or 15 minutes, as the system may take a few minutes to stabilise.
- ii) Pump should turn on, then within 20-30 seconds return line should heat up to about 8°-10°C hotter than the flow. Pump should only turn off once return line has got hot, then started to cool again.
- iii) In good sunny weather the pump should run almost continually. ROOF should be 5°-10°C hotter than TANK as shown on controller (if controller has temp display).

- iv) Overcast or winter weather the pump should cycle on and off every 2-5 minutes.

- v) If flow and return are longer than 10m, the controller PUMP ON setting may need to be increased from 8° to 12°C.

- g) Always use hot water rated pumps (up to 100°C), as high temperatures can be experienced. The pump should always be installed on the collector flow line, thus avoiding exposure to high temperatures (as a check valve is installed after the pump). Only brass, bronze or stainless steel pumps that are suitable for potable water should be used. Cast iron pumps will quickly suffer from corrosion as they are not designed for use with fresh water.

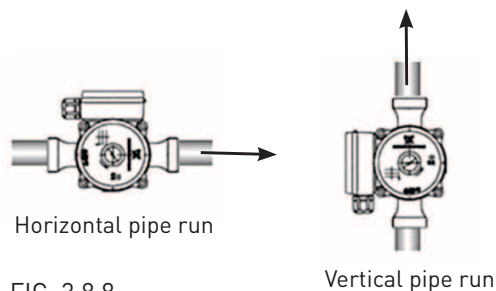


FIG. 3.8.8

f) Checking pump flow rate and operation - troubleshooting guide:

Observation	Action / Status
Return line not getting hot when pump is on	No flow. Run on speed 3 for 2-3mins to clear out air
Return line takes more than a minute to get hotter after pump turns on.	Flow rate too slow
Pump runs continually & collector temperature much higher than tank (> 20°C difference)	Flow rate too slow - or no flow. Also check collector and tank sensor positions.

- h) Cavitation can occur when an elbow or valve is too close to the suction side of the pump. Cavitation is the forming of bubbles in the water due to a low pressure zone, similar to what appears behind a propeller on a boat. This greatly reduces the efficiency of the pumping and can actually degrade the impeller reducing the life of the pump. To avoid this occurring and ensure maximum head pressure, always allow 15-20cm of straight copper pipe on both sides of the pump.
- i) It is important that the pump is installed in the correct orientation, which for a 3 speed pump is with the barrel in a horizontal position, [see figure 3.8.8]. If vertical, the bearings can quickly be damaged. In addition the electronics casing should be positioned on the side with the cable exiting the bottom to avoid water ingress. The body of the pump can be rotated easily by just removing the two bolts, and the cable gland position on the plastic case can also be easily reversed by removing the lid and rotating 180deg.

3.7. Controller Installation

3.7.1. Controller Basics

- a) In a solar thermal collector system, it is important to extract heat from the collector as quickly as possible, thus allowing the collector to run at the lowest possible temperature which in turn maximizes efficiency. The controller achieves this by measuring the temperature at the outlet of the solar collector and also the bottom of the solar storage tank. This temperature difference is referred to as a Delta-T, often written as Δt . When the collector is hotter than the bottom of the tank by a set amount, usually 8-16°C the controller will supply power to the pump which circulates water through the collector. Once the temperature levels drop below a set point, the pump turns off again. This cycle continues throughout the day, with the frequency and length of pump run dependent on solar radiation levels.

For most domestic installations the ZEN Solar controller (see section 3.9.2) is used. This controller provides basic Delta-T, maximum temperature and freeze protection functions. This unit is suitable for outdoor use.

3.7.2. ZEN Solar Controller

Figure 3.9.2.1 is a photo of the controller as it comes out of the box. Note all sensors and power cables are already connected. For most installations there is no need to complete any configuration of settings.

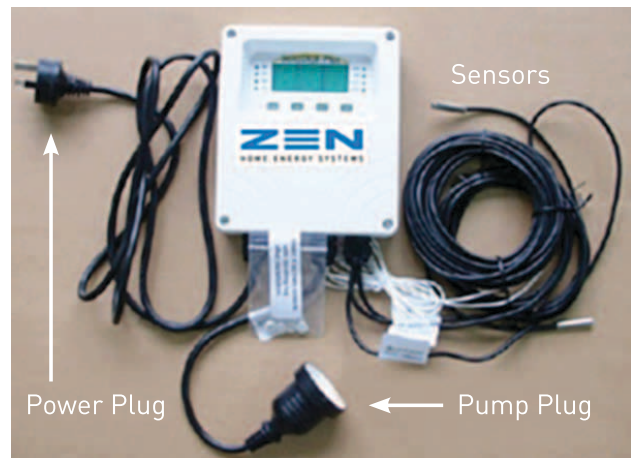


FIG. 3.9.2.1

All mains voltage electrical work must be carried out by a qualified electrician, especially external power outlet socket installation.

- a) A readily accessible disconnect device, overcurrent device and RCD Protection rated to suit the size of the pump plus 5VA must be incorporated in the power supply wiring. The overcurrent device for a 1500W, 240Vac pump must not exceed 10Amps.
- Sensor leads should be kept 300mm (12 inches) away from mains and comms cables.
 - Do not use mains power extension cords unless approved by the manufacturer. Water resistant plugs and sockets should be used.
 - The ZEN Solar Controller outputs (PUMP and HWC) will be connected to the input power supply wiring and are not isolated from it. Supply voltages will be output through that outlet during activation.
 - The HWC Relay Socket is normally used with a ZEN Solar Controller Relay or other external relay. The total current must not exceed 10A maximum.
 - Always use the unit within specified voltage and load ranges. Never use with damaged leads, plugs or sockets.
 - Do not allow the sensor cable to come within 10mm of the high voltage connectors or components inside the enclosure.
 - The electric element should have a fuse that is rated within the stated maximum of the relay driving the element.
 - Do not connect the mains or the pump to a circuit that could be switched off by your electricity supplier to manage peak loads (ripple control).
 - Comply with all local and relevant electrical regulations.

b) INSTALLATION

The ZEN Solar Controller should be mounted so that:

- It is against a flat surface with sufficient strength to hold the enclosure and any additional weight from the plugs, sockets and cables
- Power Leads face down not sideways or up,
- It is safe for users to inspect,
- The display can be easily read and buttons accessed, and
- Allowance is made for cable runs, location of power outlets and lengths of wires.

NOTE: In general, you should not need to open the controller unit during installation unless the installation is for a hot water cylinder with two elements.

Follow these steps:

1. Allow for the enclosure dropping 5mm (1/5 inch) from screw centres once mounted (keyhole mounting).
2. Place the drill guide template against the wall, checking for level alignment. Four screws are supplied: two chipboard screws and two combination plasterboard/wood screws. All four mounting holes should be used with at least two firmly secured into wood. The outer plastic plasterboard anchors will self tap into plasterboard and their inner metal screws fix into the centre of the plastic anchors.
3. Mark and drill/screw as appropriate leaving the heads of the screws above the surface by approximately 3mm (1/8 inch).
4. Place the unit over the four screw heads. The unit should slide down 5mm into the 'key' slots and become secured to the wall. You will need to adjust the screw height to obtain a secure fit.

The locations and way that the sensors are mounted is critical to ensure the ZEN controller:

- Operates correctly and at greatest efficiency;
- Protects the system against damage from extreme temperatures, and Displays hot water readings accurately.

If the TANK and/or INLET sensors are not mounted correctly:

- There may be an inaccurate Top out sensing, which could lead to damage to the hot water cylinder or other components.
- There may be an inaccurate Bio-Safe sensing,

which could increase the risk of biological contamination. Hot water readings on the display may be inaccurate.

If the ROOF sensor is not correctly mounted:

- The unit may not be able to detect FROST settings (this can lead to the collector panel bursting).

Please follow the instructions below carefully.

c) SENSORS

Positioning the ROOF Sensor

The 10m ROOF sensor should be fitted into a metal immersion 'pocket' in the hot water outlet pipe.

Apply plenty of heat transfer compound (available from your distributor) between the sensor and the lining of the hot water outlet pipe.

Seal the sensor with neutral cure sealant and install external lagging. The cable should also be insulated from the bare pipe.

Positioning the TANK Sensor

The INLET sensor should be fitted into a metal immersion 'pocket' above the HWC electric element near the bottom of the tank (usually just above the element).

If a 'pocket' is not available, then bond the sensor against the metal wall of the tank (not the outside cladding or insulation).

Apply plenty of heat transfer compound (available from your distributor) between the sensor and the lining of the 'pocket' (or between the tank and the sensor).

d) PROGRAMMING

The solar controller comes pre-set with suitable settings for most domestic applications:

PUMP ON = 8°C

Temperature differential at which the pump turns ON.

PUMP OFF = 1°C

Temperature differential at which the pump turns OFF.

TOP OUT = 60°C

Maximum tank temperature. When exceeded; pump turns OFF.

FROST = 2°C

When collector drops below this temperature pump circulates to raise temp by 2°C.

The instruction manual provided with each of the controls, refers to an "installer code" to access the programming mode. This code is simply: HWC then

NEXT then PUMP. To enter the programming mode press TEST, then wait for the lights to stop flashing before entering the code. Please read the controller manual for complete details.

e) DISPLAY

The controller provides a digital display providing the two sensor temperatures, as well as information when programming the functions. (See figure 3.9.2.2.) To cycle through the temperature display press the NEXT button, the current displayed sensor is indicated by the LED on the left hand side (INLET LED will also show the TANK temperature).

f) MANUAL PUMP CONTROL

Holding down the PUMP button will run the circulation pump, as may be required during initial system air bleeding or to check for suitable flow. Suitable flow rate would be indicated by a decrease in the collector temperature as the water passes through, so is an easy way to check if there is an air lock, or insufficient flow.

3.8. Evacuated Tube & Heat Pipe Installation

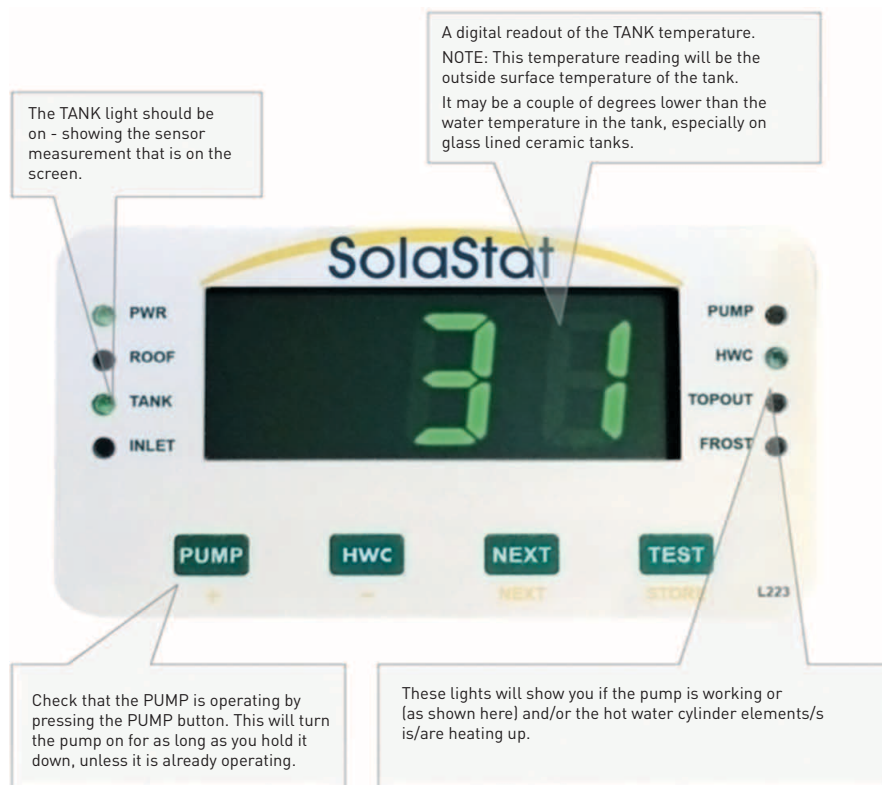
The ZEN solar collector is a simple “plug in” system. The heat pipe and evacuated tube assembly just needs

to be plugged into the manifold. The contact between the heat pipe condenser/tip and heat pipe port in the header needs to be tight in order to ensure good heat transfer. Under normal use, once the heat pipes are installed they should never have to be removed, even if replacing a damaged evacuated tube.

DO NOT INSTALL THE HEAT PIPES AND EVACUATED TUBES UNTIL SYSTEM PLUMBING IS COMPLETED AND PUMP AND CONTROLLER ARE OPERATIONAL, UNLESS TUBES ARE COVERED. WEAR SAFETY GLASSES AT ALL TIMES WHEN HANDLING EVACUATED TUBES.

a) If an evacuated tube is damaged for any reason (i.e. knocked heavily or dropped), it will need to be replaced. Either use another tube with heat pipe already inserted, or if a plain evacuated tube spare is being used, carefully remove the heat pipe from the broken tube and insert into the new tube. This should be done with care, holding the heat pipe close to the tube opening and inserting by making a short push and twisting action. Never throw heat pipes away, as they are very sturdy and will not be damaged even if the tube has been. They can be kept as spares, or inserted into plain spare evacuated tubes. If a heat pipe is bent it can be easily be straighten by hand or by rolling on a flat surface like a rolling pin.

FIG. 3.9.2.2



3.8.2. Heat Pipe and Evacuated Tube Insertion

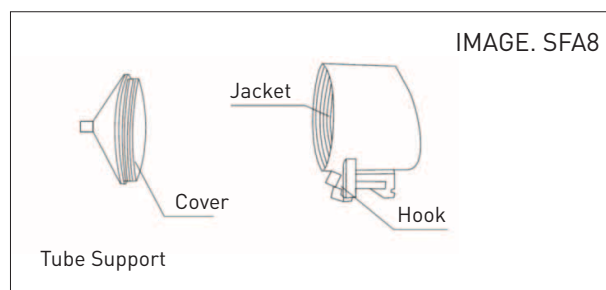
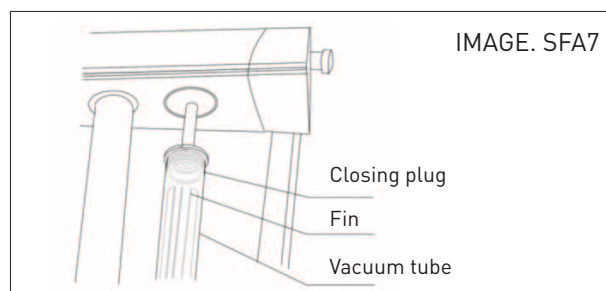
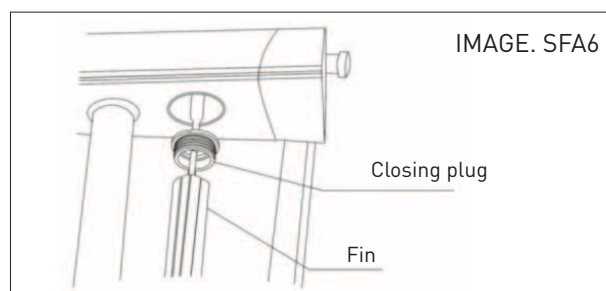
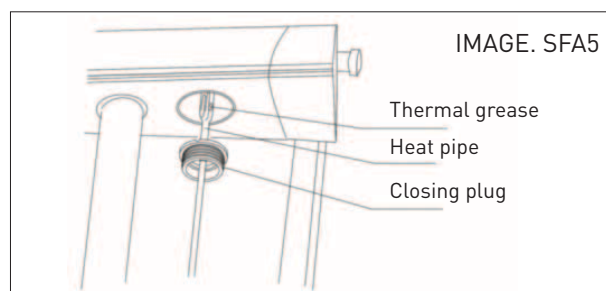
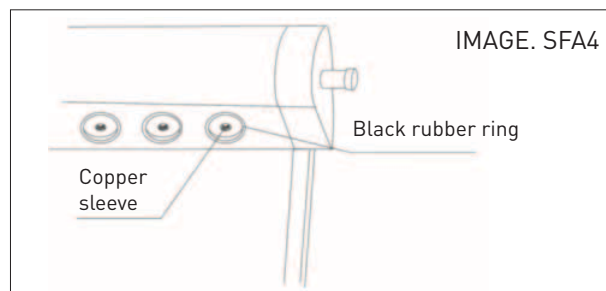
Step 1. Place the black rubber rings into the holes in the header with even parts on the upper side and uneven parts on the lower side; (image SFA4)

Step 2. The heat pipe should be inserted into a closing plug which is about 2cm away from the condensing section (the upper part of the pipe). Then apply the thermal silicon grease to the upper part and insert the heat pipe into the copper sleeve in the inner tank; (image: SFA5)

Step 3. Assemble the fins around the thin part of the pipes; (image: SFA6)

Step 4. Moisturize the vacuum tube opening or the black rubber ring with water; then one person clenches the fins together and the other person inserts a vacuum tube from the lower part of fins, keeping the vacuum tube and heat pipe concentric. Move the vacuum tube forward and insert the closing plug to the vacuum tube until the uncoated part of the vacuum tube is fully inserted into the black rubber ring; You may lubricate the tube with graphite or other lubricants. (image SFA7)

Step 5. Push the jacket to the end of the vacuum tube and fix it to the tube bottom rack, and then install the cover; Screw up the retaining strap with a cross recessed pan head screw. Make sure the gap between the two holes is less than 15mm. (image: SFA8)



3.8.3. Post Installation Cleaning

- a) Clean each evacuated tube with a liquid glass cleaner and cloth/paper.

3.9 Post Installation

3.9.1. Collector Operation

- a) After installing all the tubes, and given good sunlight, the solar collector will begin to produce heat after a 5-10min "warm up" period. Check the controller and pump for correct operation and adjust settings as required.

3.9.2. Take Photograph

- a) Always take several photos of the solar collector on the house roof. These serve as an important record if you ever receive a phone call from the home owner about the installation.
- b) Send a copy of ALL installation photos to ZEN Energy as a record of the installation, and for use on their websites and in promotional material.

3.9.3. Installation Record Form

- a) Complete the triplicate installation record form, which is available from ZEN Home Energy. This form should be completed with the original and a copy left with the owner, and a copy retained by the installer. The owner is required to fax or mail the original to ZEN Energy, 33 King Street, Norwood SA 5067

4. Maintenance

Under normal conditions the solar collector is maintenance free. Please refer to the documentation provided by the manufacturer of other components for maintenance guidelines.

The following maintenance may ONLY be completed by Authorised PERSONS

4.1. Broken Tube

- a) If a tube is broken it should be replaced as soon as possible to maintain maximum collector performance.
- b) The system will still operate normally and safely even with a tube broken.
- c) Any broken glass should be cleared away to prevent injury. ALWAYS WEAR SAFETY GLOVES AND GLASSES.
- d) To replace a tube:
 - Remove the tube clip(s), slide broken tube out and carefully pick up any glass pieces. Protective gloves must be worn when handling broken glass.
 - If the heat pipe is not easily removed, it can be left in place and a new evacuated tube inserted, guiding the heat pipe down the groove between the evacuated tube inner wall and heat transfer fin. If the heat pipe is easily removed, the easiest option is to replace the heat pipe and evacuated completely.

4.2. Insulation

- a) The plumbing pipes running to and from the collector should be heavily insulated. This insulation foam should be checked periodically (at least once every 3 years) for damage.
- b) For any insulation that is exposed to sunlight, ensure any protective cover/wrap/foil is in good condition, replacing as required.

4.3. Draining the Collector

Draining of the manifold may be required if maintaining the system. Periodic flushing of the system is NOT required unless in areas with hard water resulting in scale formation in the bottom of the tank.

Step 1. Turn off the mains water supply to the solar storage tank.

Step 2. If the storage tank is being concurrently drained, refer to section 2.15. If storage tank is not being drained, isolate piping to and from the solar collector (isolation valves should already be installed), and IMMEDIATELY open drain cocks on both lines (or undo fittings). Allowing the collector to sit pressured

with the isolation valves closed may lead to leaks or dangerously high pressure. CAREFUL THE WATER MAY BE HOT.

Step 3. Open an air vent or drain cock, or undo a fitting on the manifold outlet to allow air to enter the system, permitting the solar loop to drain of liquid.

Step 4. Allow the manifold to sit in a vented state for 5-10min to allow the manifold to boil dry (may need longer in poor weather).

Step 5. Close the air vent or drain cock, or re-fasten fitting. CAREFUL THE PIPING MAY BE HOT

4.4. Other Components

- a) For the replacement of Sacrificial anodes, these should be maintained in accordance to their manufacturer's own maintenance guidelines and Other parts of the system such as the pump and storage tank (electric or gas water heater) should be serviced/inspected according to their manufacturer's own maintenance guidelines.

4.5. Freezing

- a) During extended sub-zero periods with concurrent pump/controller failure or power outage, a direct flow (water) system may suffer from freeze related damage, indicated by no pump flow due to pipe blockage, or in most cases leaking due to a split pipe.
- b) The most likely area of freeze damage is exposed copper piping, particularly near elbows or connections. Once the system thaws, leaks will indicate any areas of damage which require replacement.
- c) To repair, isolate flow to the collector or drain the system and repair/replace any damaged piping, then recommission the system.
- d) If freezing is a regular occurrence, consider installing a battery power backup system to ensure continued operation of the pump and controller during a power outage. To provide complete protection the system may need to be upgraded to a closed loop anti-freeze (potable grade heat transfer fluid) system.

5. Troubleshooting

Problem	Cause	Solution
1. Pump always ON even during minimal solar radiation conditions.	Air lock in manifold.	Ensure system is air bled properly. A ball valve and drain should be installed on the return line allowing the drain to be opened, ball valve shut off, thus flushing the collector. Take care as some steam may be released.
	Insufficient flow rate.	Check flow rate by temporarily installing flow meter. If not sufficient try: **Ensure there is 15-20cm of straight pipe both sides of the pump to ensure optimal operation. **Eliminating any unnecessary elbows or bends in copper line to reduce pressure drop. **Change the pump to a higher speed setting. **Confirm correct pump orientation (see figure 3.8.8).
	Pump Cavitation.	Bleed the pump of air by opening the top bleed screw. Also ensure there is at least 15cm of straight pipe on both sides of the pump.
2. Pump not cycling during good weather and collector is hot.	Collector sensor (ROOF) not inserted properly.	Coat with thermal paste, insert into the port beside outlet and check operation.
	Faulty sensors.	Check sensor operation by putting ROOF sensor in hot water, INLET sensor in cold water, the pump should come on. Replace one or both sensors and re-check operation.
3. Pump running at night.	Freeze protection operating.	This is normal, but if the pump is running more than once an hour, additional insulation on the collector line should be used.
4. Not enough hot water.	Electric or gas booster is not configured correctly.	Ensure gas booster is operational. For electric systems, fit an automatic timer for the element power supply set to run from 3pm to 6pm, providing a boost each day. End user can over-ride to turn the element ON for a few hours if they need additional hot water.

Problem	Cause	Solution
5. Hot water dumping from tank PTR.	High temperature setting in controller not functioning to turn off pump.	Check to ensure TOP-OUT function is set to 60°C. Check TANK sensor contact.
6. Excessively hot water delivered to house taps.	No tempering valve installed.	Install tempering valve, providing 50°C water supply to house.
7. Banging noise in tank when hot water tap is opened.	Cold water entering the bottom of the tank mixing from the solar return line. Increased when inlet cold pressure is low (<400kPa).	Check cold supply water pressure. Install pressure pump to raise cold supply pressure above 400kPa. Install heat trap on return solar line.
8. Banging noise in pipe even when hot water is not being used.	Check valve (duo-valve) may not be installed on cold mains line, combined with low supply water pressure (<400kPa).	Install check valve (duo-valve) on cold line before tank. Install pressure pump to raise cold supply pressure above 400kPa.
	Check valve on cold line not sealing.	Replace with new check valve. Cold expansion valve or PTRV should be dumping water each day.
9. Poor solar contribution.	Insufficient flow rate	See Troubleshooting point 1.
	Is working fine, but customer has turned booster off.	Explain to customer that in the winter or poor weather the tank will not heat up to full temperature, refer to section 1 of this manual. Boosting is still needed all year round and will operate as needed.
	Damaged tubes.	Check to ensure tubes are all intact. Replace any damaged tubes.
	Incorrect installation of heat pipes.	Heat pipes are not inserted into the ports correctly, or do not have coating of heat transfer paste.
	Low installation angle, reducing winter output (if any angle is less than the latitude).	Increase installation angle to at least latitude angle, and preferably 10-15° greater than latitude.
	Insufficient insulation resulting in excessive heat loss.	Ensure all exposed copper pipe is insulated and protected against UV degradation.
	Thermosiphoning at night.	Install heat trap (U shaped copper pipe) on collector return pipe just before tank inlet.
	Increased hot water demand.	If the customer is using a lot more hot water than in the past then the % solar contribution will be reduced even though solar output may be the same.

6. Safety Reminders

6.1. Metallic Components

- a) Always wear leather protective gloves when handling solar collector components. All efforts have been made to make the metal components safe to handle, but there may still be some sharp edges.

6.2. Evacuated tubes

- a) Be careful when handling the evacuated tubes, as they will break if knocked heavily or dropped.
- b) If exposed to sunlight and therefore hot (have internal pressure built up), the tubes may explode rather than implode if knocked and broken. This is a rare occurrence, but nevertheless safety precautions should be taken.

SAFETY GLASSES SHOULD BE WORN AT ALL TIMES WHEN HANDLING EVACUATED TUBES

- c) If the evacuated tubes are struck by a hard object with sufficient force (I.e. branch falling on roof), they may break. During installation consideration should be taken as to the possible path any broken glass may take. Where possible protection should be implemented to prevent broken glass from reaching ground level where somebody could walk on it (I.e. Guttering on roof).
- d) The home owner should be made aware by the installer the location of the solar collector and the possible vicinity of broken glass in the event of an extreme storm or object falling on the collector.

6.3. High Temperatures

- a) With the heat pipe installed in the evacuated tube, and good sunlight, the heat pipe tip can reach temperatures in excess of 200°C / 392°F. At this temperature touching the heat pipe will result in serious burns, so thick leather gloves must be worn when handling hot tubes and heat pipes.
- b) In an installed fully plumbed system, if the pump is stopped during good sunlight the collector header and plumbing pipe close to the manifold can easily reach temperatures in excess of 160°C, and therefore caution should be taken when handling such components.

6.4. Health & Safety

- a) Always wear safety glasses when handling evacuated tubes.
- b) Wear leather gloves when handling metal components.
- c) Wear thick leather gloves if handling hot heat pipes.
- d) Adhere to safety regulations regarding working on roofs (or at a height).

7. Installation Checklist

The following list is a guide only. Specific items will depend on the nature of the installation.

1	Collector faces as close as possible to due North	YES	NO
2	Collector is not significantly shaded throughout the day.	YES	NO
3	Collector is not likely to be struck by falling objects such as branches, falling fruit, or other nearby objects	YES	NO
4	Collector is installed at an angle of between 20° – 80°, preferably at latitude angle or higher	YES	NO
5	In areas prone to large hail (→20mm), collector is installed at an angle of 40° or greater	YES	NO
6	Frame is secured to structurally sound roof/wall	YES	NO
7	Plumbing is leak free	YES	NO
8	Plumbing pipe runs are well insulated	YES	NO
9	Exterior insulation above is protected against sunlight with foil wrap or equivalent.	YES	NO
10	Functional checks for controller and pump have been completed	YES	NO
11	Pressure relief valve drain pipe will dump only onto high temperature resistant material and will not pose a danger of scolding people.	YES	NO
12	Pump, controller and all electrical connections are protected from water ingress	YES	NO
13	Evacuated tubes have been cleaned	YES	NO
14	This basic operation of the collector has been explained to the end user.	YES	NO
15	Water quality has been checked (if applicable)	YES	NO
16	Installation record form has been completed and the original left with customer	YES	NO

All items should be ticked YES for the installation to be considered completed and satisfactory.

8. Appendices

8.1. Appendices

Appendix A – Flat Roof Frame Assembly

Appendix B – ZEN Solar Electric water heating system (Stainless Steel Solar Tank)

Appendix C – ZEN Solar Gas water heating system (Stainless Steel Solar Tank)

Appendix D – ZEN Solar Electric water heating system (Vitreous Enamel Solar Tank)

Appendix E – ZEN Solar Gas water heating system (Vitreous Enamel Solar Tank)

Appendix A - Flat Roof Frame Assembly

Parts - Distinguish the different part according to the quantity list below

No.	Name	Quantity
1	Upper connector	3
2	Bottom connector	6
3	Diagonal track	3
4	Vertical track	3
5	Bottom track	2
6	Bar	4
7	L corner	12

IMAGE 1

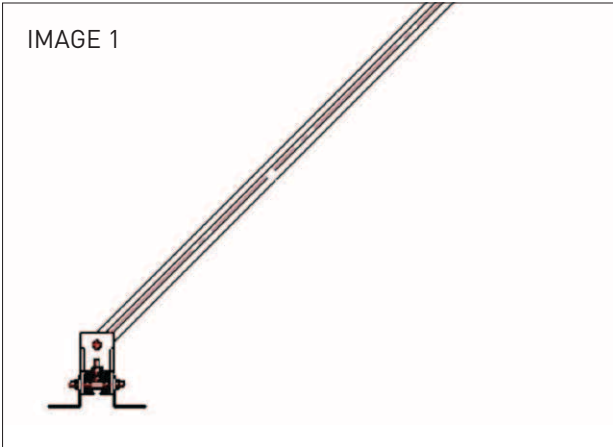
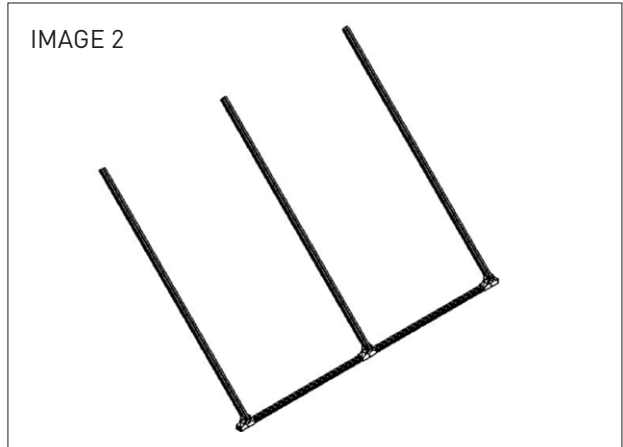


IMAGE 2



Step 1: One bottom track and 3 pieces of diagonal tracks are assembled together by 3 pieces of bottom connectors (see Image 1 and 2). Image 3 for connecting detail.

IMAGE 3

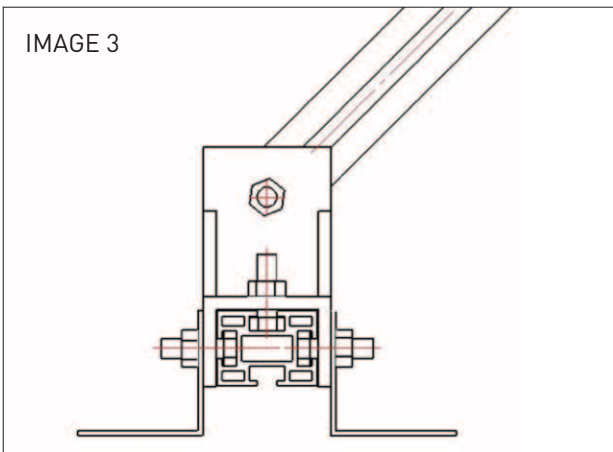


IMAGE 4



Step 2. The other bottom track and 3 pieces of vertical tracks are assembled together by 3 pieces of bottom connectors (see Image 4)

Step 3. The 4 pieces of bars are assembled as shown in Image 4. The result is Image 5.

IMAGE 5

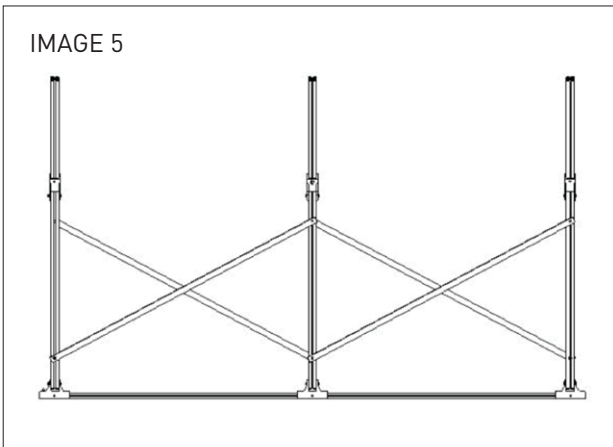
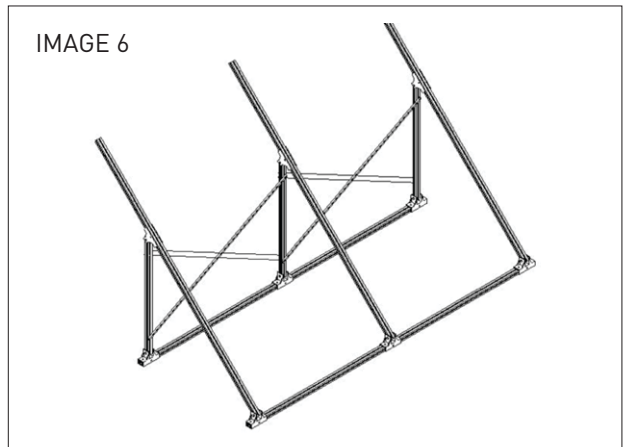


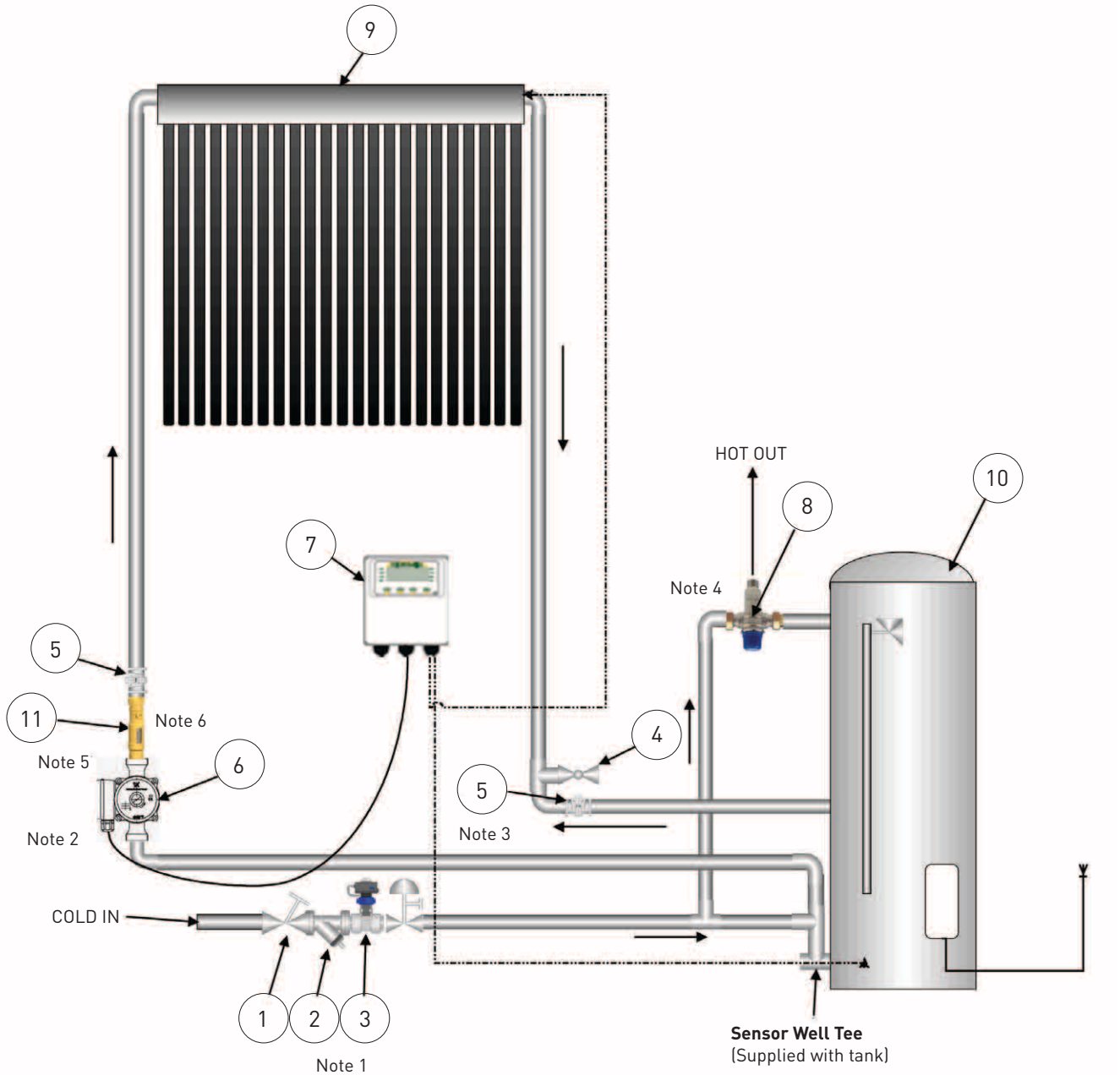
IMAGE 6



Step 4. Assemble the configurations shown in Image 5 and Image 2 together. The result is Image 6.

Appendix B

ZEN Solar Electric water heating system (Stainless Steel Solar Tank)



Bill Of Materials *

NO.	Component Name	QTY.	Supplier Part Number
1	Non Return Isolation Valve	1	AS Approved
2	In-line Strainer	1	AS Approved
3	Pressure Limiting Valve (500kPa)	1	AS Approved
4	Air Bleed Valve	1	AS Approved
5	Solar Non-Return Valve	2	AS Approved
6	Circulation Pump	1	UPS15-20
7	ZEN Solar controller	1	Sola-stat-plus-1
8	Tempering Valve	1	Heatguard Ultra 15
9	ZEN Evacuated Tube Collector	1	HRJ-32/1.8
10	ZEN Stainless Steel Tank	1	250/315ES
11	Ajustable flow control	1	Flow control regulator

* Materials in **bold** supplied by ZEN Energy.

NOTES:

1. Optional Inclusion, compulsory in some states.
2. Allow 150mm of straight pipe either side of the collectors
3. For runs longer than 20m, use DN20mm copper.
4. Tempering Valve Must be installed.
5. Solar compatible non-return valves are to be used -
no synthetic valve seats are to be used.
6. The installation manual specifies the flow required, so that it can match the modelling parameters.
1L/min was used in the modelling and this can be achieved in real installation accurately.

System diagrams have been designed in line with AS/NZS2712 requirements.

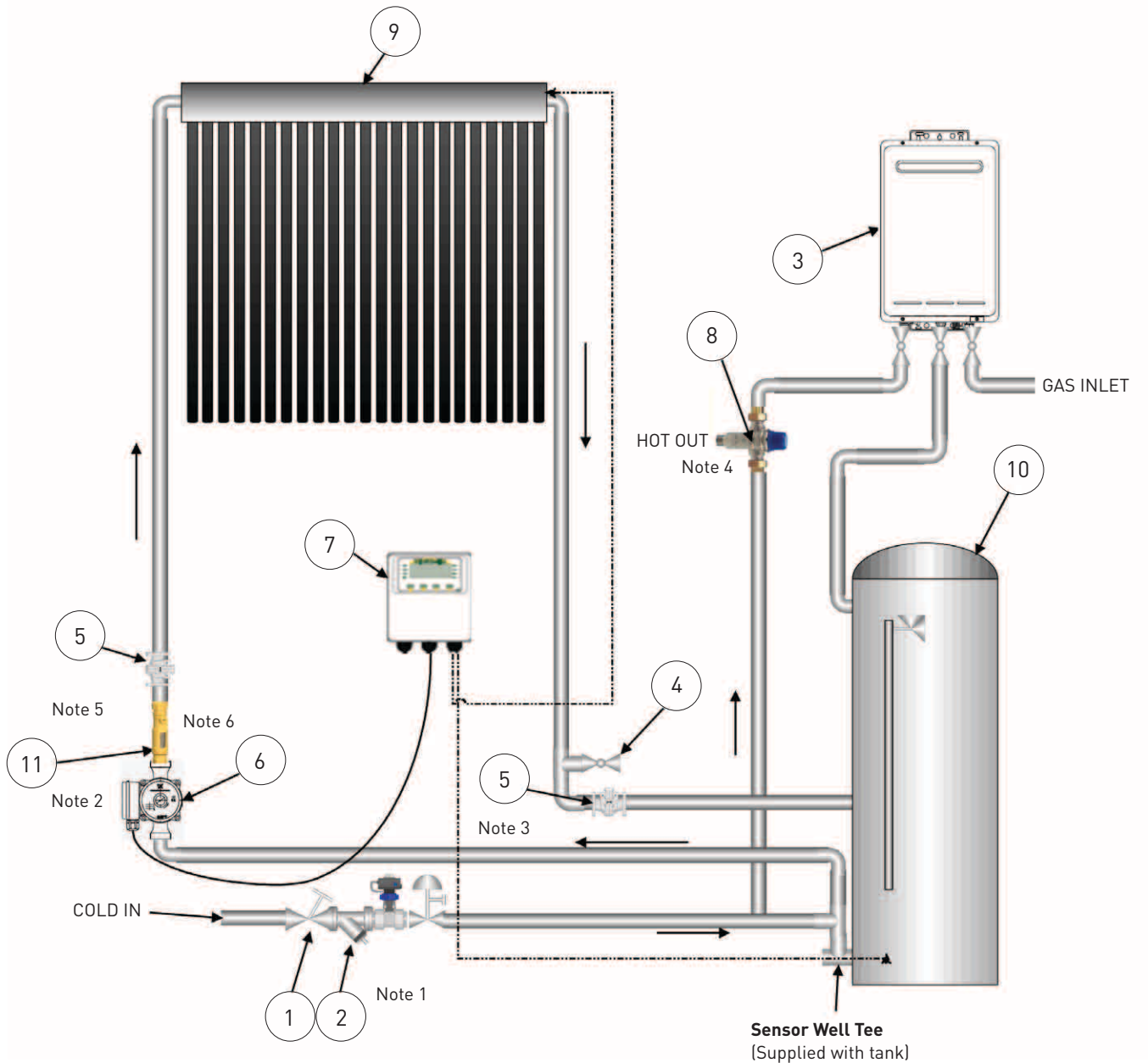
The installer must not change the design of the system or use alternative major system components. It is the responsibility of the installer/contractor to ensure that the system design meets all relevant standards, regulations and guidelines, and is safe and operating correctly.

Any installer/contractor must be legally certified to install solar water heating systems and have attended an accredited ZEN training session before completing the installation of any ZEN Solar Thermal products.

Product Description	ZEN - Solar Thermal Stainless Steel Electric Boosted Tank System
Model Numbers	ZEN-250/315-30SS-E
Document Number	ZEN-ST-2011-v12.1
Designer	T. Ielasi
Date Created	21/11/2011
Revision Number	1.0 Rev (Oct - 2012)

Appendix C

ZEN Solar Gas water heating system (Stainless Steel Solar Tank)



Bill Of Materials *

NO.	Component Name	QTY.	Supplier Part Number
1	Non Return Isolation Valve	1	AS Approved
2	In-line Strainer	1	AS Approved
3	ZEN Gas Booster	1	S20/S26
4	Air Bleed valve	1	AS Approved
5	Solar Non-Return Valve	1	AS Approved
6	Circulation Pump	1	UPS15-20
7	ZEN Solar controller	1	Sola-stat-plus-1
8	Tempering Valve	1	Heatguard Ultra 15
9	ZEN Evacuated Tube Collector	1	HRJ-32/1.8
10	Everlast Stainless Steel Tank	1	250/315GS
11	Flow control regulator	1	Flow control regulator

* Materials in **bold** supplied by ZEN Energy.

NOTES:

1. Optional Inclusion, compulsory in some states.
2. Allow 150mm of straight pipe either side of the collectors
3. For runs longer than 20m, use DN20mm copper.
4. Tempering Valve Must be installed.
5. Solar compatible non-return valves are to be used - no synthetic valve seats are to be used.
6. The installation manual specifies the flow required, so that it can match the modelling parameters.
1L/min was used in the modelling and this can be achieved in real installation accurately.

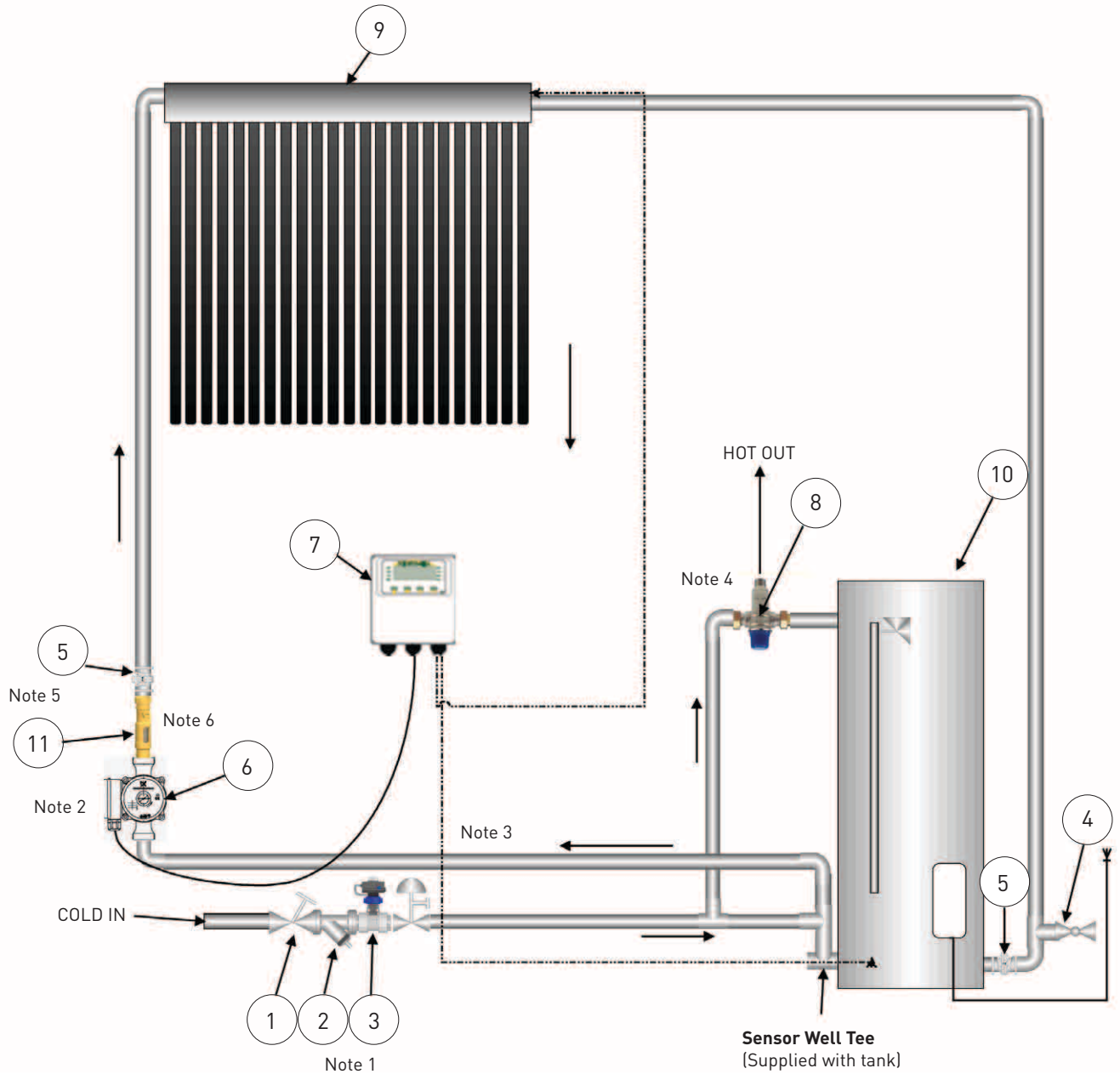
System diagrams have been designed in line with AS/NZS2712 requirements. The installer must not change the design of the system or use alternative major system components. It is the responsibility of the installer/contractor to ensure that the system design meets all relevant standards, regulations and guidelines, and is safe and operating correctly.

Any installer/contractor must be legally certified to install solar water heating systems and have attended an accredited ZEN training session before completing the installation of any ZEN Solar Thermal products.

Product Description	ZEN - Solar Thermal - Stainless Steel Gas Boosted Tank System
Model Numbers	ZEN250/315-30SS-S20/S26
Document Number	ZEN-ST-2011-v12.3
Designer	T. Ielasi
Date Created	21/11/2011
Revision Number	1.0 Rev (Nov-2011)

Appendix D

ZEN Solar Electric water heating system (Vitreous Enamel Solar Tank)



Bill Of Materials *

NO.	Component Name	QTY.	Supplier Part Number
1	Non Return Isolation Valve	1	AS Approved
2	In-line Strainer	1	AS Approved
3	Pressure Limiting Valve (500kPa)	1	AS Approved
4	Air Bleed Valve	1	AS Approved
5	Solar Non-Return Valve	1	AS Approved
6	Circulation Pump	1	UPS15-20
7	ZEN Solar controller	1	Sola-stat-plus-1
8	Tempering Valve	1	Heatguard Ultra 15
9	ZEN Evacuated Tube Collector	1	HRJ-32/1.8
10	Rinnai Vitreous Enamel Tank	1	SE315 (DSF-24315)
11	Adjustable flow control	1	flow control regulator

* Materials in **bold** supplied by ZEN Energy.

NOTES:

1. Optional Inclusion, compulsory in some states.
2. Allow 150mm of straight pipe either side of the collectors.
3. For runs longer than 20m, use DN20mm copper.
4. Tempering Valve Must be installed.
5. Solar compatible non-return valves are to be used - no synthetic valve seats are to be used.
6. The installation manual specifies the flow required, so that it can match the modelling parameters.
1L/min was used in the modelling and this can be achieved in real installation accurately.

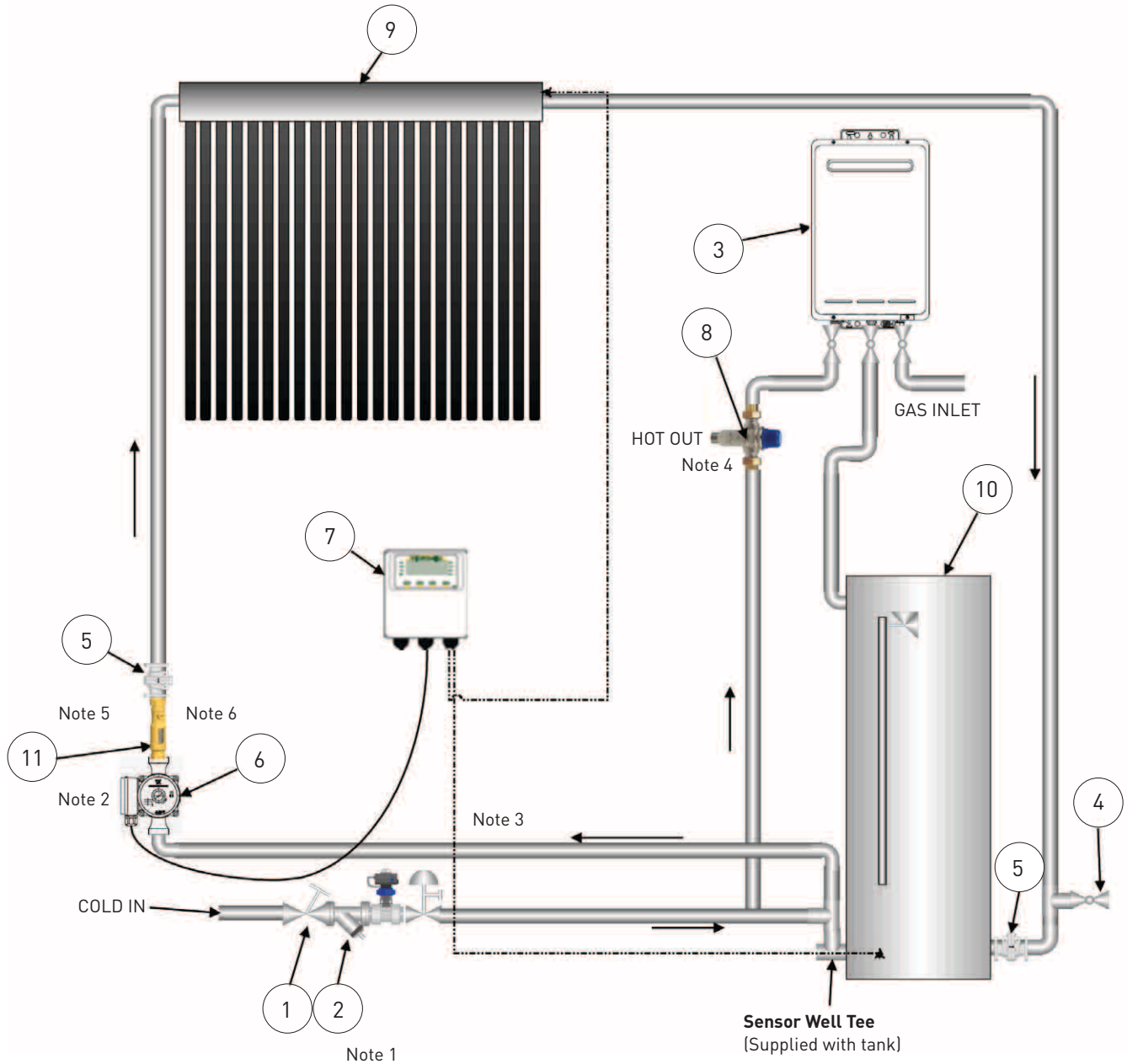
System diagrams have been designed in line with AS/NZS2712 requirements. The installer must not change the design of the system or use alternative major system components. It is the responsibility of the installer/contractor to ensure that the system design meets all relevant standards, regulations and guidelines, and is safe and operating correctly.

Any installer/contractor must be legally certified to install solar water heating systems and have attended an accredited ZEN training session before completing the installation of any ZEN Solar Thermal products.

Product Description	ZEN - Solar Thermal Vitreous Enamel Electric Boosted Tank System
Model Numbers	ZEN315-30VE-E
Document Number	ZEN-ST-2011-v12.2
Designer	T. Ielasi
Date Created	21/11/2011
Revision Number	1.0 Rev (Oct-2012)

Appendix E

ZEN Solar Gas water heating system (Vitreous Enamel Solar Tank)



Bill Of Materials *

NO.	Component Name	QTY.	Supplier Part Number
1	Non Return Isolation Valve	1	AS Approved
2	In-line Strainer	1	AS Approved
3	ZEN Gas Booster	1	S20/S26
4	Air Bleed valve	1	AS Approved
5	Solar Non-Return Valve	1	AS Approved
6	Circulation Pump	1	UPS15-20
7	ZEN Solar controller	1	Sola-stat-plus-1
8	Tempering Valve	1	Heatguard Ultra 15
9	ZEN Evacuated Tube Collector	1	HRJ-32/1.8
10	Rinnai Vitreous Enamel Tank	1	SG270 (DSF-24250)
11	Adjustable flow control	1	Flow control regulator

* Materials in **bold** supplied by ZEN Energy.

NOTES:

1. Optional Inclusion, compulsory in some states.
2. Allow 150mm of straight pipe either side of the collectors.
3. For runs longer than 20m, use DN20mm copper.
4. Tempering Valve Must be installed.
5. Solar compatible non-return valves are to be used - no synthetic valve seats are to be used.
6. The installation manual specifies the flow required, so that it can match the modelling parameters.
1L/min was used in the modelling and this can be achieved in real installation accurately.

System diagrams have been designed in line with AS/NZS2712 requirements. The installer must not change the design of the system or use alternative major system components. It is the responsibility of the installer/contractor to ensure that the system design meets all relevant standards, regulations and guidelines, and is safe and operating correctly.

Any installer/contractor must be legally certified to install solar water heating systems and have attended an accredited ZEN training session before completing the installation of any ZEN Solar Thermal products.

Product Description	ZEN - Solar Thermal - Vitreous Enamel Gas Boosted Tank System
Model Numbers	ZEN270-30VE-S20/S26
Document Number	ZEN-ST-2011-v12.4
Designer	T. Ielasi
Date Created	21/11/2011
Revision Number	1.0 Rev (Nov-2011)

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