QUICK GUIDE

TO

SOLAR SYSTEMS

Envirosol
Solar Hot Water Heating™

CONTENTS

FOREWORD

Thank you for purchasing a Firebird Envirosol™ solar system. Our solar systems are built to the highest manufacturing and quality standards and are suitable for both domestic and commercial use.

This Solar Guide is intended to give you an overview of Firebird solar systems. More detailed information and installation instructions are provided with most of the solar system components and those instructions override any component information contained in this summary guide.

We would ask that you carefully read both this guide and the instructions accompanying each of the system components before commencing any installation work. Should you have any questions do not hesitate to our technical department.

Failure to adhere to any instructions may invalidate your product warranty and any extended warranty programme that is in place. Please note that the installer must conform to local regulations and the responsibility for proper solar system design lies with the installer/ building contractor.

APPROVALS & CERTIFICATIONS

All components used on the Firebird Envirosol solar thermal systems are CE approved. In addition all Firebird solar collectors are tested to EN 12975 and are approved under the globally recognised Solar Keymark & DIN Geprüft schemes.

A. SCOPE OF SUPPLY

Depending on the extent of your solar order, you will receive some of the following components shown below. Detailed installation instructions are provided with most solar system components and the information provided therein overrides information in this summary guide.

Solar Collectors

❑ **Flat Panel, CPK-7210N**	
❑ **U-Pipe Vacuum Tube, CVSKC-10**	
❑ **Heat Pipe Tube, TZ58-1800** [not for sale in the UK]	

Mounting fixtures

❑ **On-roof installation (pitched roof)**	
❑ **In-roof recessed installation (flat panel only)**	
❑ **Installation on flat roof or surface**	

Solar Water Storage Tank

❑ **Stainless Steel Water Storage Tanks;** twin coil unvented or triple coiled vented tanks available	

Pump Station/ Controller

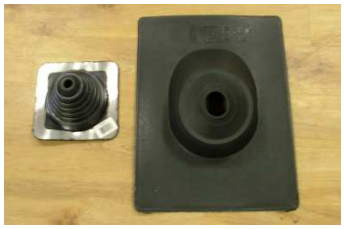
❑ **Pump Station and Solar Controller**	

Other Solar System Components

❑ **Expansion vessel** - Available in 24L and 35L sizes	
❑ **Air vent & isolation valve** Vents solar system during commissioning. Should be isolated afterward.	
❑ **3-way mixing valve** –Controls temperature of DHW exiting hot water storage tank	

❑ **Solar Anti-freeze fluid** Pink= for vacuum tube / Heat Pipe Blue = for flat roof	 
❑ **Stainless Flexible pipe and fittings** Vacuum Tube/Heat Pipe Fittings: ¾" male by 22mm compression ¾" female by 22mm compression Flat Panel Fittings: 1" male by 22mm compression 1" female by 22mm compression	

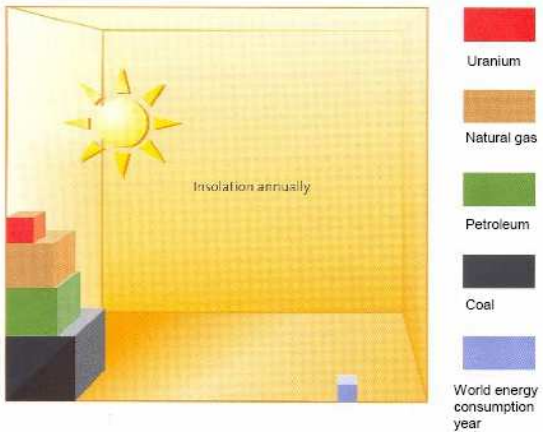
Solar Accessories

❑ **Pipe Flashing** for tiled and slate roof	
❑ **Solar Weather-proof Cover** For vacuum tube and flat panel	
❑ **Solar stainless steel insulated twin pipe**	
❑ **Expansion Vessel Accessory Kit** includes check valve, wall bracket & flexi hose	
❑ **Filling & flushing pump station**	

B. INTRODUCTION TO SOLAR HOT WATER HEATING

B1. Why Solar Heating?

Solar is one of the fastest growing 'renewable technologies, and when you compare the amount of solar energy available during the year, with the remaining fossil fuel reserves the earth has to offer, it is easy to see why the uptake of solar thermal systems has been so rapid.
The large yellow cube below represents the amount of energy received by the sun each year. The small blue cube represents the amount energy contained in the fossil fuel mankind burns each year. As can be seen, the annual worldwide energy consumption is just a tiny fraction of the solar energy incident on the earth.



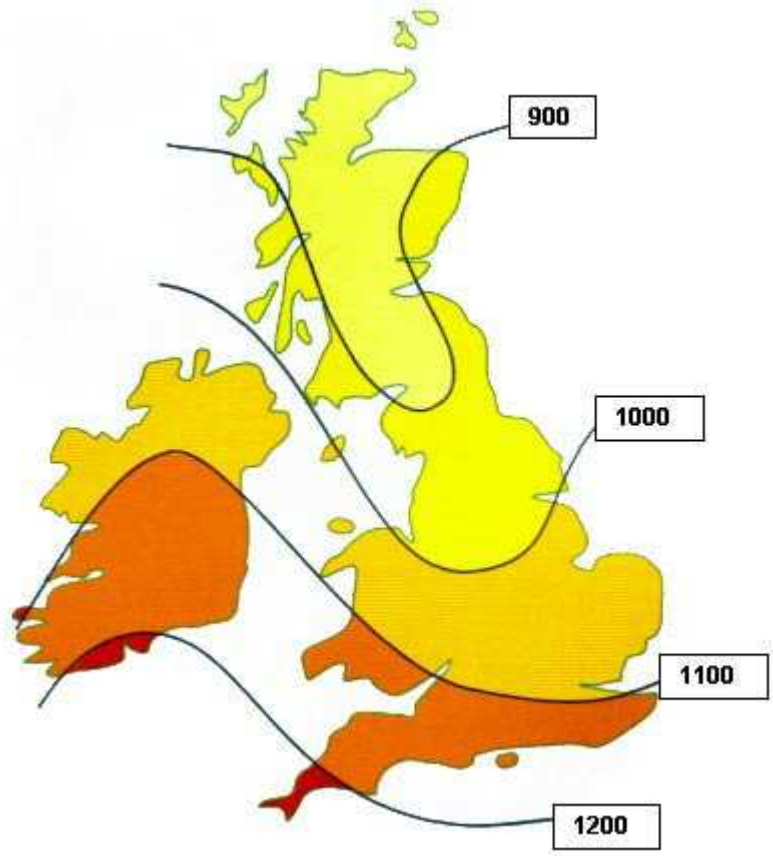
Source: Solar Thermal Systems.

Just some of the benefits of solar water heating

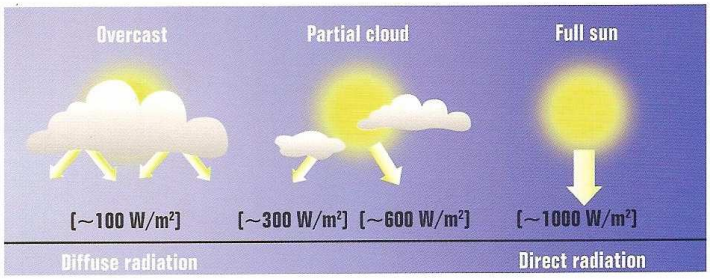
- **Savings** - An Envirosol solar heating system can cut your heating bills by up to 90% in the summer and up to 30% in the winter, on average this equates to approximately 50-70% reduction in your costs.
- **Environment** - Households create almost 30% of all CO^2 emitted in Ireland/UK. Your Envirosol solar collector will save approx 1 tonne of CO^2 from being emitted to the earth's atmosphere.
- **Energy Independence -** With decreasing reserves of fossil fuels, increasing reliance on distant suppliers, you and your family will be cushioned from future fuel shortages and price increases.
- **Boiler Maintenance** – Less wear and tear on your boiler
- **Building Energy Rating (BER)** - The addition of a solar water heating system can have a dramatic impact on your BER, leading to an increase in house value, possibly covering the installation costs, if not more.
- **Building Regulations –** With new building regulations aimed at reducing carbon emissions from new buildings, a solar water heating system is an ideal solution for providing easy Part L compliance.

B2. Is there enough sun to make the system economic?

In Ireland/UK a horizontal surface of 1 m^2 receives an average of between 1,000 and 1,200 kWh of solar energy per year (the equivalent of 120 litres of oil). This is actually more than in Paris. Both direct sunlight (40%) and indirect sunlight (60%) provide this energy. So, even when the sky is overcast and you can't see the sun, its radiation (sunlight) is available at ground level and can be converted into useful heat by your Envirosol Solar Panels. During the summer months the Envirosol Solar Heating System could provide the total energy needs for heating all your water.



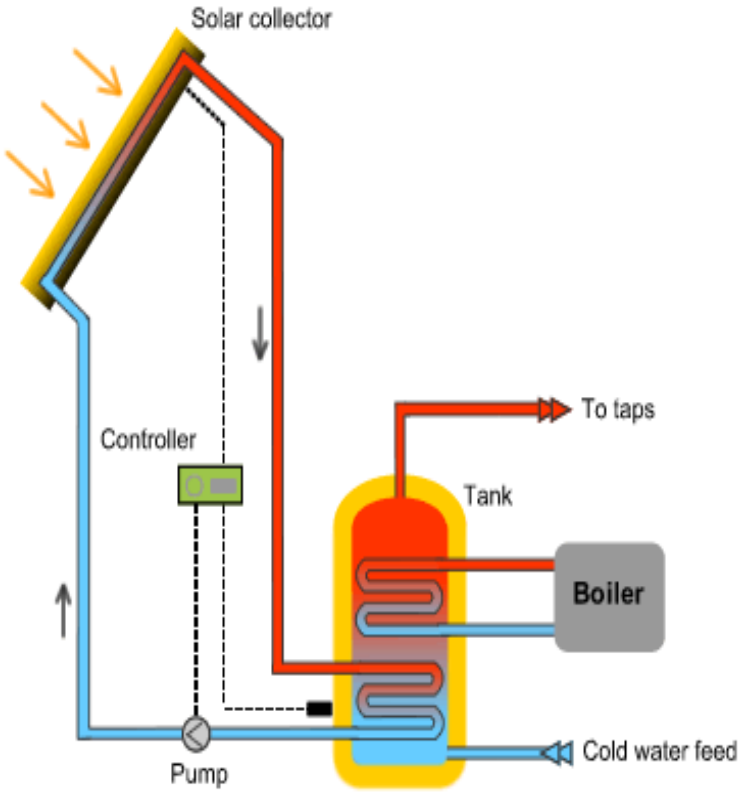
Map Source: Solar Trade Association



2b.

B3. Solar Hot Water Heating Explained

Specially coated roof panels or ‘collectors’ on your roof absorb both direct solar radiation and atmospheric diffused radiation. The energy absorbed is converted to heat through a series of pipes containing a special anti-freeze type liquid. The heated water is then pumped via a controller to heat your hot water tank which is also heated from a conventional boiler to make up the 30%+ of your domestic hot water needs. Envirosol systems use only high efficiency oil boilers (Sedbuk Band A and recommended by the Energy Saving Council) to provide the conventional part of your energy needs.

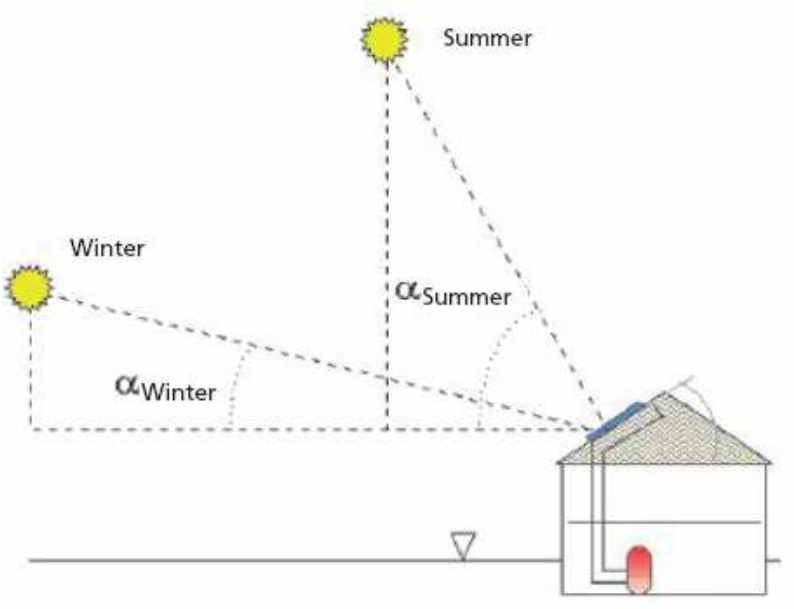


Direct & Diffused Radiation

- Direct Radiation is where the sunlight reaches the earth’s surface uninterrupted.
- Diffused Radiation is where the suns rays are partially blocked by cloud cover or other atmospheric median and are diverted towards the earth’s surface.
- Diffused Radiation provides most of the "daylight" in our rooms, i.e. north facing windows.55% – 62% of the solar radiation reaching ground level in Ireland is diffused.

Angle of Inclination – Azimuth

Solar collectors should be positioned between 30º and 60º to the horizontal. In the Summer 35º inclination would be ideal, whilst in the winter 50º to 75º inclination would give best results. However it's not practical to adjust inclination during the year.

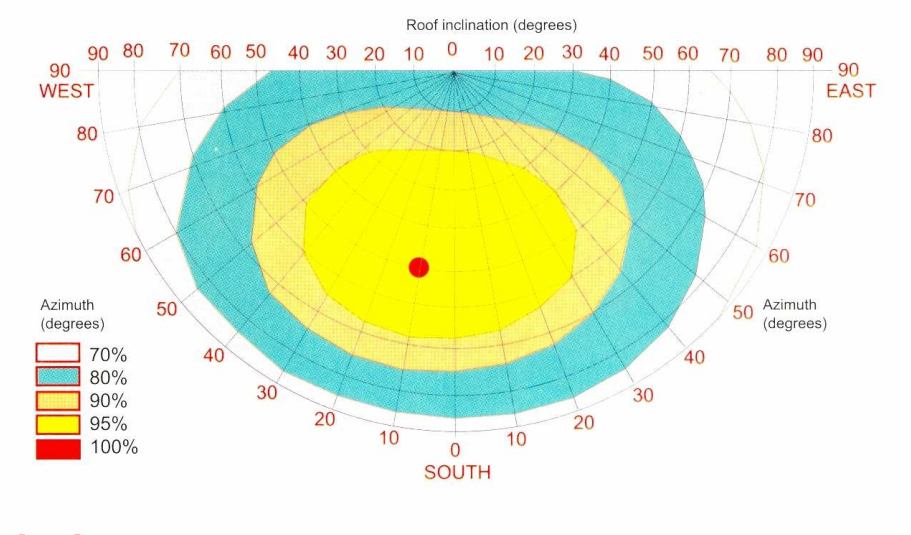


Orientation

- In the northern hemisphere collectors should be pointed directly south to receive maximum solar radiation.

- The annual energy collection only varies by a maximum of 10% for surfaces facing anywhere between 30º east of south and south west and tilt angles of 20º to 45º. This flexibility means that a large proportion of existing buildings have roof orientations and angles suitable for solar energy systems.

The figure below shows the performance of solar hot water systems at various orientations and inclinations



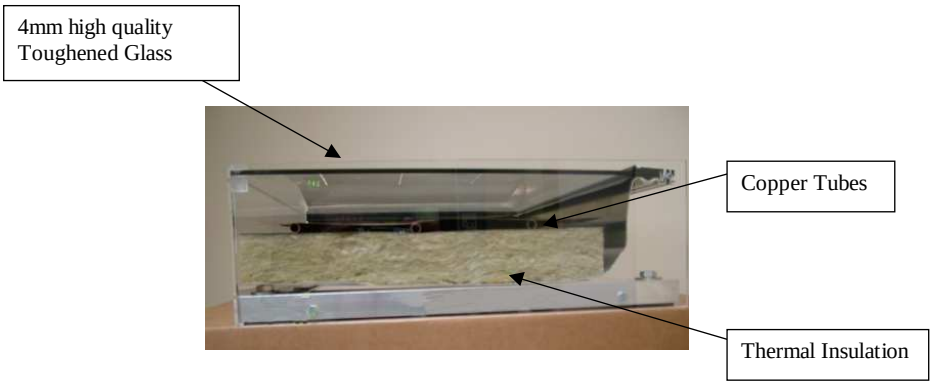
C. COLLECTOR SPECIFICATIONS

C1. Flat Panel, CPK-7210N

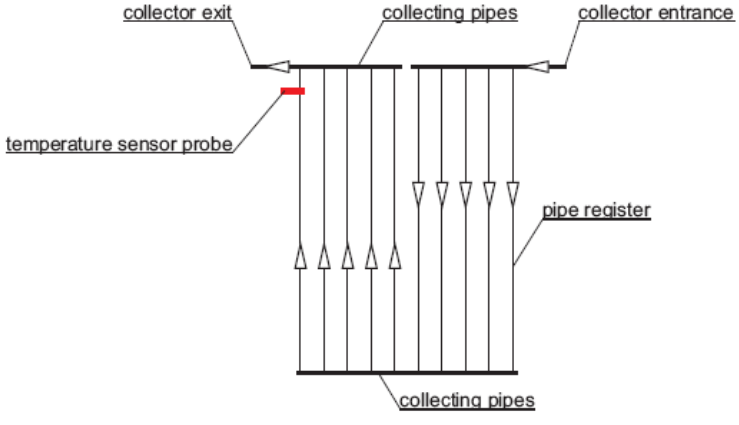
The Firebird CPK7210N Flat Plate collector is specially designed to maximize the absorption and retention of solar radiation. The collector contains an absorber plate made of copper and coated with a highly selective TiNOX absorber coating. This surface greatly enhances the collector's ability to capture and retain solar energy.

A Heat transfer fluid flows through a grid of double parallel copper tubes which are ultrasonically welded to the back of absorber plate. The 40mm mineral wool insulation (U = 0.045 W/mK) on the back of the absorber, protects the heat collected and aids against heat loss. A sheet of 4mm toughened glass covers the collector as it faces the sun, and this helps to prevent most of the convection losses. Furthermore, it reduces heat radiation from the absorber into the environment in a similar way as a greenhouse does.

Cross-section of the Firebird Flat Plate collector (CPK-7210)



The diagram below shows an overview of the formation of pipe-work in the CPK-7210 collector. The grid of double parallel copper tubes prolong the fluid flow through the collector, allowing a balanced distribution and temperature difference across the array of collectors.

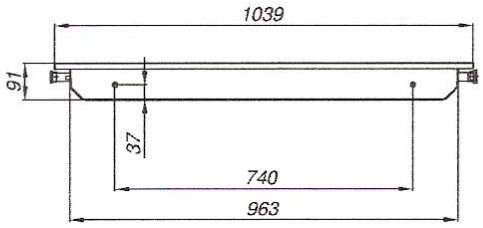


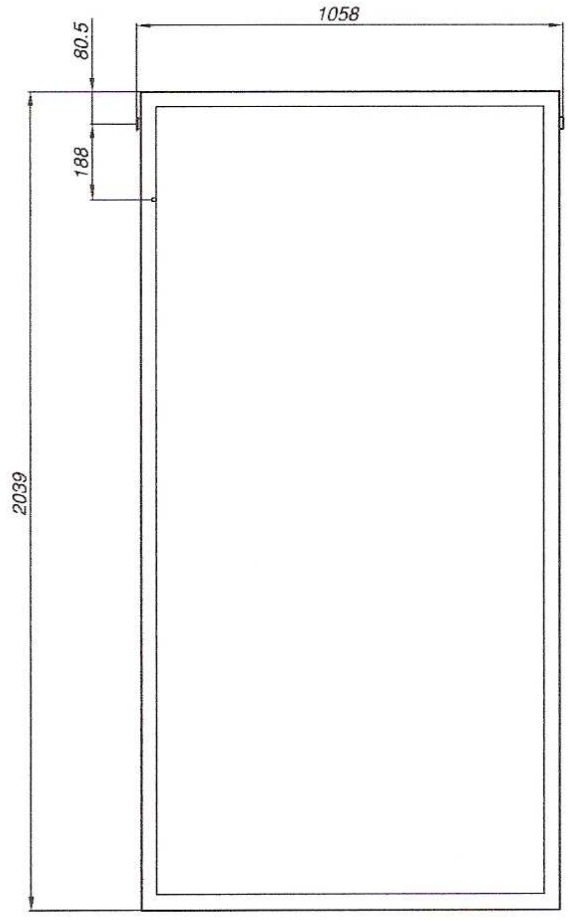
Collector Specifications: CPK 7210N

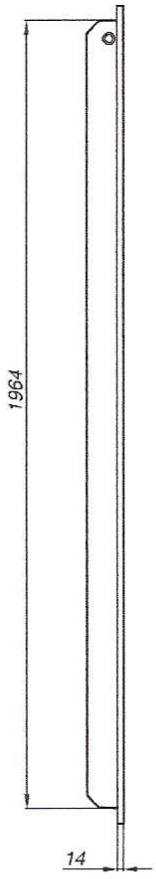
Type	**CPK 7210N**
Collector Outer Dimensions: Height [mm] Width [mm] Depth [mm]	 2038 1039 98
Weight [Kg]	38
Gross collector area [m2]	2.11
Aperture area [m2]	1.79
Max Operating Pressure [bar]	10
Stagnation temperature [ºC]	216
Angle of inclination permitted	15º to 75º
Flow rate	0.5 to 1.5 l/min per m2 of aperture
Solar anti-freeze fluid	Tyfocor L
Performance data;	
Zero-loss collector efficiency, η0 (based on aperture area)	81.8%
Collector heat loss coefficient, a1 [W/m2 K]	3.29
Collector performance ratio, a1/η0 [W/m2 K2]	0.0134
Absorption	> 95%
Emission	< 5%
Annual Energy Yield [kWh/m2] (based on aperture area)	> 525

Dimensions of Flat Panel Collector, CPK 7210N

Technical data					
Gross area	m^2	2,12	Weight	kg	39
Net area	m^2	1,8	Contents	l	1,4
Apertur	m^2	2,0	max. Pressure	bar	10







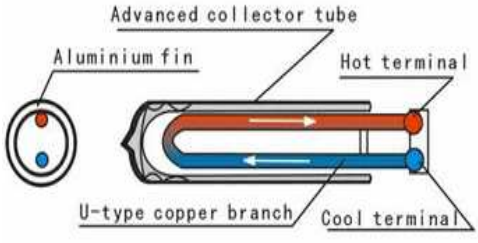
C2. U-Pipe Vacuum Tube, CVSKC-10

The Firebird CVSKC-10 U-Pipe Vacuum tube offers one of the best performance to area of any collector on the market and deliver higher efficiency in less favourable weather conditions.

Each solar tube consists of two glass tubes made from extremely strong borosilicate glass. The outer tube is transparent allowing light rays to pass through with minimal reflection. The inner tube is coated with a special selective coating, which features excellent solar radiation absorption and minimal reflection properties. The tops of the two tubes are fused together and the air is withdrawn "evacuated" from the space between the two glass tubes to form a vacuum, which eliminates conductive and convective heat loss. This means wind and low temperatures have less of an effect on the function of evacuated tubes when compared to flat plate solar collectors due to the insulating properties of the vacuum.

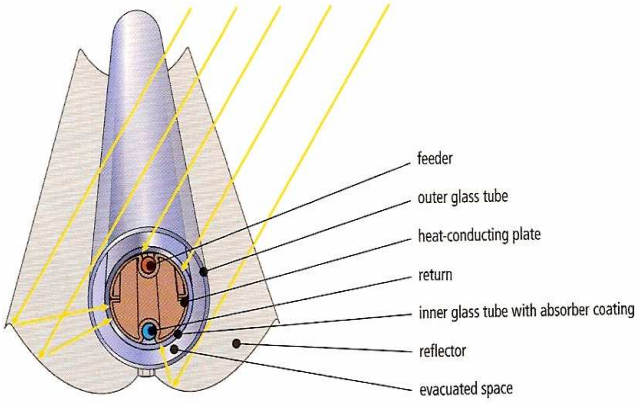
Direct Flow Vacuum Tube Collector- The CSVKC-10 collector is a U-pipe direct flow tube type often called a ‘Sydney’ tube. The heat transfer fluid flows inside a U shaped pipe within the inner tube (absorber) of each solar tube.

The selective coating on the inner tube converts solar energy into heat energy and transfers heat to the copper U tube by means of a close fitting aluminium plate. The heat transfer fluid (usually glycol-water antifreeze mixture) in the U tube is heated, and conducts the heat energy to the water inside the storage tank through a plate exchanger or internal spiral coils.



As the fluid takes its energy directly from the sun, the heat collecting effectiveness is very high, and the efficiency remains at a constant, high level throughout the product life because the U tube does not degrade.

CPC Mirror - In order to increase the efficiency of the Firebird vacuum tube a highly reflective, weather- proof CPC Mirror (Compound Parabolic Concentrator) is placed behind the evacuated tubes, "tracking" the sun, ensuring that direct and diffuse sunlight strikes the absorber, even when the angles of irradiation are unfavourable (such as easterly early morning and westerly late afternoon light).



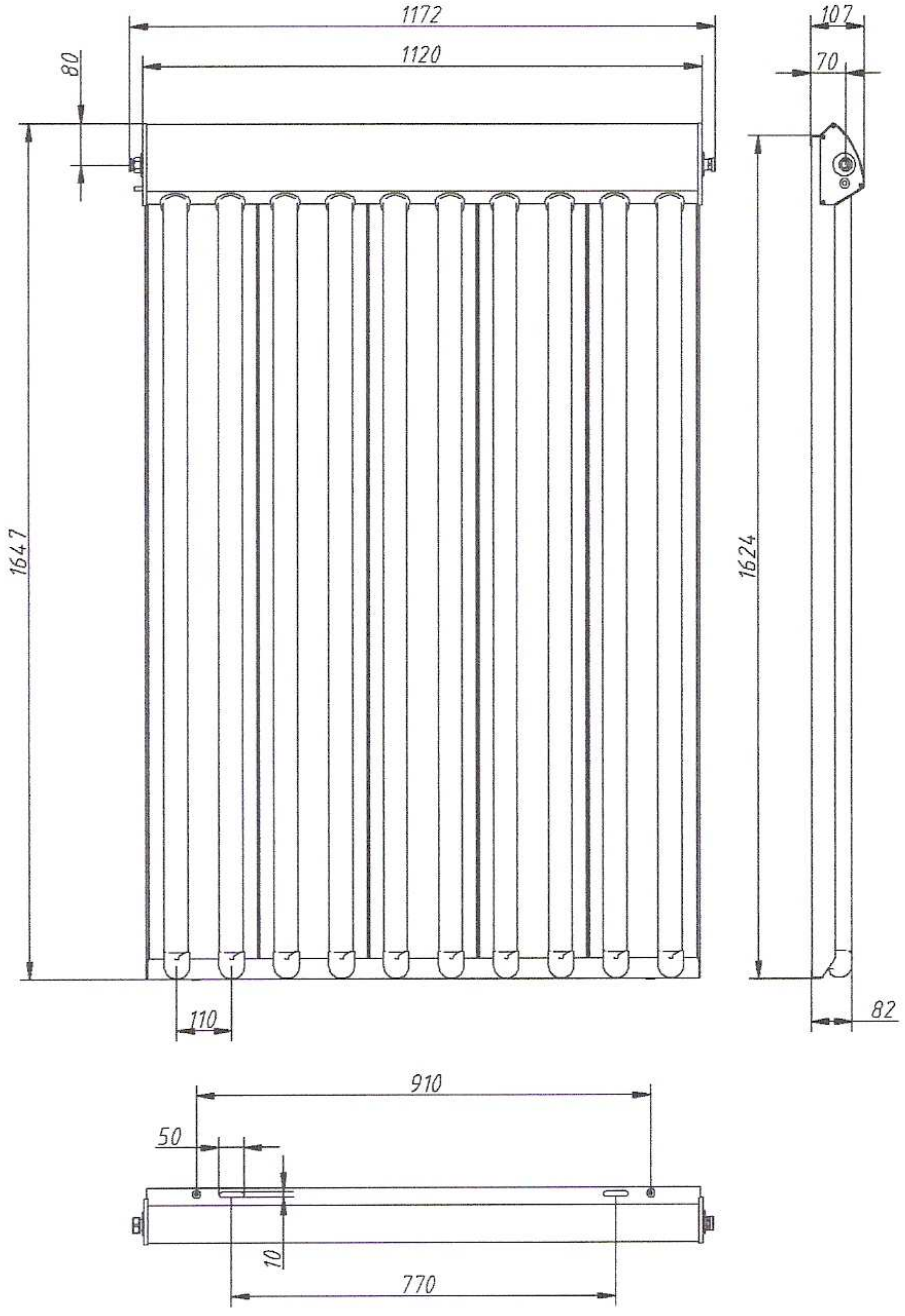
The CPC reflector makes a significant contribution to an extremely high-energy yield as the radiation that usually passes through the gap between tubes is driven back onto the 360^{o} absorber area.

Collector Specifications: CVSKC-10

Type	CVSKC-10
Collector Outer Dimensions: Height [mm] Width [mm] Depth [mm]	 1645 1115 107
Weight [Kg]	31
Gross collector area [m2]	1.83
Aperture area [m2]	1.59
Max Operating Pressure [bar]	10
Stagnation temperature [ºC]	286
Angle of inclination permitted	15º to 75º
Flow rate	0.5 to 1.5 l/min per m2 of aperture
Solar anti-freeze fluid	Tyfocor LS
Performance data;	
Zero-loss collector efficiency, η0 (based on aperture area)	60.5%
Collector heat loss coefficient, a1 [W/m2 K]	0.850
Collector performance ratio, a1/η0 [W/m2 K2]	0.010
Absorption	> 96%
Emission	< 6%
Annual Energy Yield [kWh/m2] (based on aperture area)	> 529

Dimensions of U-Pipe Vacuum Tube, CVSKC-10

Technical data					
Gross area	m^2	1,84	Weight	kg	31
Net area	m^2	1,69	Contents	l	1,63
Apertur	m^2	1,60	max. Pressure	bar	10



C3. Heat Pipe Tubes, TZ58-1800

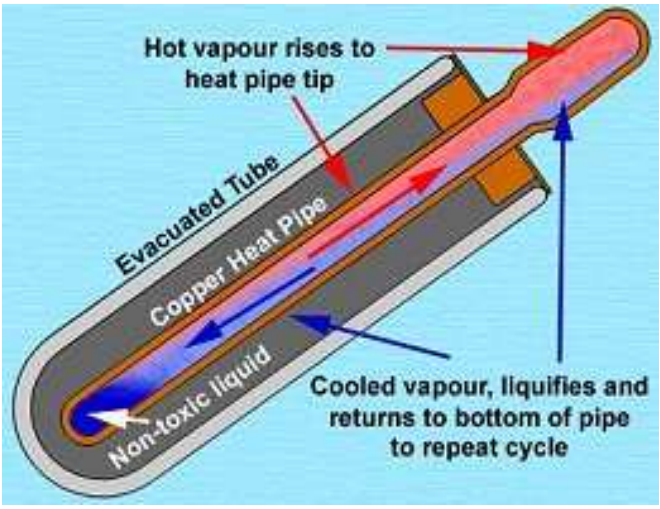
[not for sale in the UK]

The TZ58-1800 heat pipe solar collectors are the latest addition to the Firebird solar range and offer an optimum performance to price ratio. Built to Firebird's exacting standards, they have an extremely high efficiency and can deliver solar energy even in overcast weather conditions.

How the TZ58 Heat Pipes Work:

The TZ58 heat pipes consist of a borosilicate glass tube with a near-perfect vacuum with a selective absorber coating applied to its inner surface. A copper heat pipe is located inside the heat pipe which contains an alcohol-type fluid that can evaporate at temperatures as low as 25ºC.

Solar energy is absorbed onto the absorber surface on the glass tube and then transfers to the heat pipe, causing the alcohol-type fluid to heat-up and turn to vapour. As the fluid evaporates it rises to the top of the heat pipe, known as the condenser section. Here it condenses back to fluid state and releases latent heat which is transferred to the heat exchange fluid passing through the upper manifold. The condensed liquid flows back to the bottom of the heat pipe to once again repeat the process



Key Features of the TZ58 Heat Pipes

- High build quality – aluminium manifold design, nickel plated condenser head, borosilicate glass
- High efficiency vacuum tube - round shaped absorber tube ensures solar energy is captured throughout the day
- Heat pipe technology - manifold can be installed initially and tubes added later during commissioning

Collector Specifications: TZ58-1800 *[not for sale in the UK]*

Type	**TZ58-1800 20 tube set**	**TZ58-1800 30 tube set**
Collector Outer Dimensions: Height [mm] Width [mm] Depth [mm]	 2020 1825 155	 2020 2655 155
Heat Pipe dimensions Diameter [mm] Length [mm]	 58 1800	 58 1800
Weight [Kg]	78	115
Gross collector area [m2]	3.507	5.005
Aperture area [m2]	1.867	2.791
Max Operating Pressure [bar]	6	6
Stagnation temperature [ºC]	200	200
Angle of inclination permitted	15º to 75º	15º to 75º
Flow rate	0.5 to 1.5 l/min per m2 of aperture	0.5 to 1.5 l/min per m2 of aperture
Solar anti-freeze fluid	Tyfocor LS	Tyfocor LS
Performance data;		
Zero-loss collector efficiency, η0 (based on aperture area)	73.4%	73.4%
Collector heat loss coefficient, a1 [W/m2 K]	1.529	1.529
Collector performance ratio, a1/η0 [W/m2 K2]	0.0166	0.0166
Absorption	> 94 %	> 94 %
Emission	< 7%	< 7%
Annual Energy Yield [kWh/m2] (based on aperture area)	> 525	> 525

D. HEALTH AND SAFETY INFORMATION

When fitting Firebird Solar Systems, installers should comply with all relevant health and safety regulations and recommendations. Proper safety and protective clothing should be worn, including hard hats, boots, gloves and where appropriate eye protection.

	If no mechanical fall protection or fall arrest systems are provided, working without suitable safety harnesses can lead to falls from great heights, thus causing serious or lethal injuries.		Safety harnesses should be fixed above the users where possible. These harnesses should only be fixed to structures or fixing points with sufficient load- bearing capacity.
	If mechanical fall protection or fall arrest systems cannot be installed for technical reasons, safety harnesses must be worn.		Do not use damaged ladders.
	Only use safety harnesses that have been tested and certified by authorised testing bodies.		Ensure that ladders are put up safely. Observe the correct leaning angle (68º-75º).
	Ladders not properly secured against sinking in, sliding or falling over may lead to dangerous falls.		Only lean ladders against secure points.
	Contact with live overhead cables can be lethal.		Wear protective goggles when drilling.
	Wear cut-proof safety gloves when carrying out installation work.		Wear safety shoes when carrying out installation work.
	Wear a helmet when carrying out installation work.		

Subject to health and safety we should point out some important matters:

- When handling the collectors remember that they have been designed to convert light into heat and accordingly parts of them will get very hot if left out in the sun even for short periods of time. If you touch parts of the collectors after this exposure you may get severe burns because temperatures may well exceed boiling.

- When working at heights always use proper scaffolding and safety harnesses.
- Always access the risks before you start work.
- Take care when carrying the collectors to a roof. Carrying and manipulating heavy weights and large frames onto a roof is difficult and can cause you to slip.
- Always make sure you have sufficient people to help you in your work.
- Always comply with all wiring and electrical instructions and regulations, including bonding rules, when installing the pump station and controller.
- Do not open or attempt to service the panels. There are no user serviceable parts inside.
- All solar packaging is recyclable so please dispose of it in an environmentally friendly way.

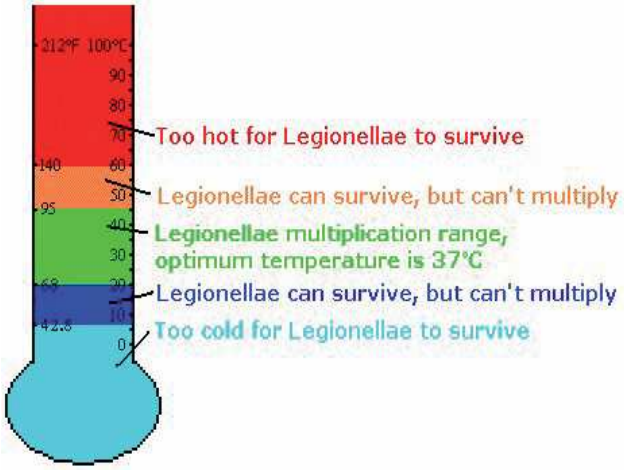
E. SOLAR SYSTEM DESIGN & SIZING

Before commencing the installation of a solar system, the following points should be checked.

- The solar system design, installation and commissioning must comply with all relevant European, national and local standards
- Does the roof or structure have sufficient load bearing capacity to support the collectors?
- The intended orientation of the collectors should be as close to true South as possible. South-west or south-east facing installations are also acceptable and will only incur minor losses.
- Avoid shadowing of the collectors from trees or nearby buildings
- For Northern Europe, the ideal inclination angle is between 40º and 50º to the horizontal
- Make sure that there's enough free space on the roof to fit the intended number of collector tubes, bearing in mind position of roof windows, chimneys, etc.

E1. Safeguarding against Legionnaire's Disease

As with any water heating system, when designing a solar thermal system, one needs to be aware of the risks of Legionnaires' disease.



Legionnaires' disease is a type of pneumonia named after an outbreak of severe pneumonia which affected a meeting of the American Legion in 1976. It is an uncommon but serious disease caused by improper storage of water at lukewarm temperatures.

Legionnellae will grow at its maximum rate at around 37℃. At 60℃ it is killed off within seconds. To protect against Legionnellae in a solar installation

- Ensure that water is stored above 60ºC
- Ensure frequent circulation of water in the storage tank
- Sterilise the system if the premises are unoccupied for any length of time before using any hot water.
- The water system should be flushed out on a regular basis to prevent the water from stagnating.

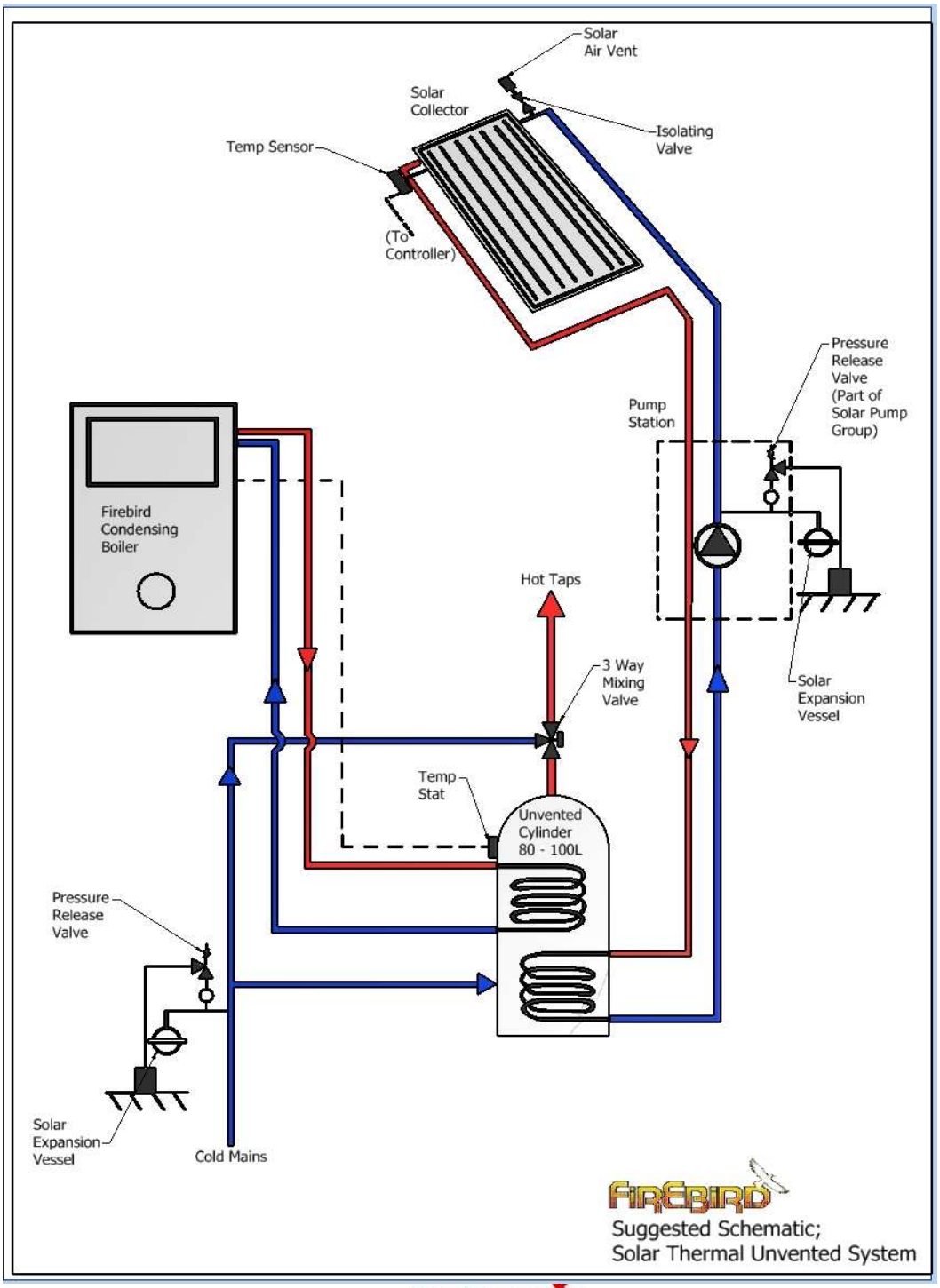
E2. Typical System Layouts

The following pages show three typical solar system concepts:

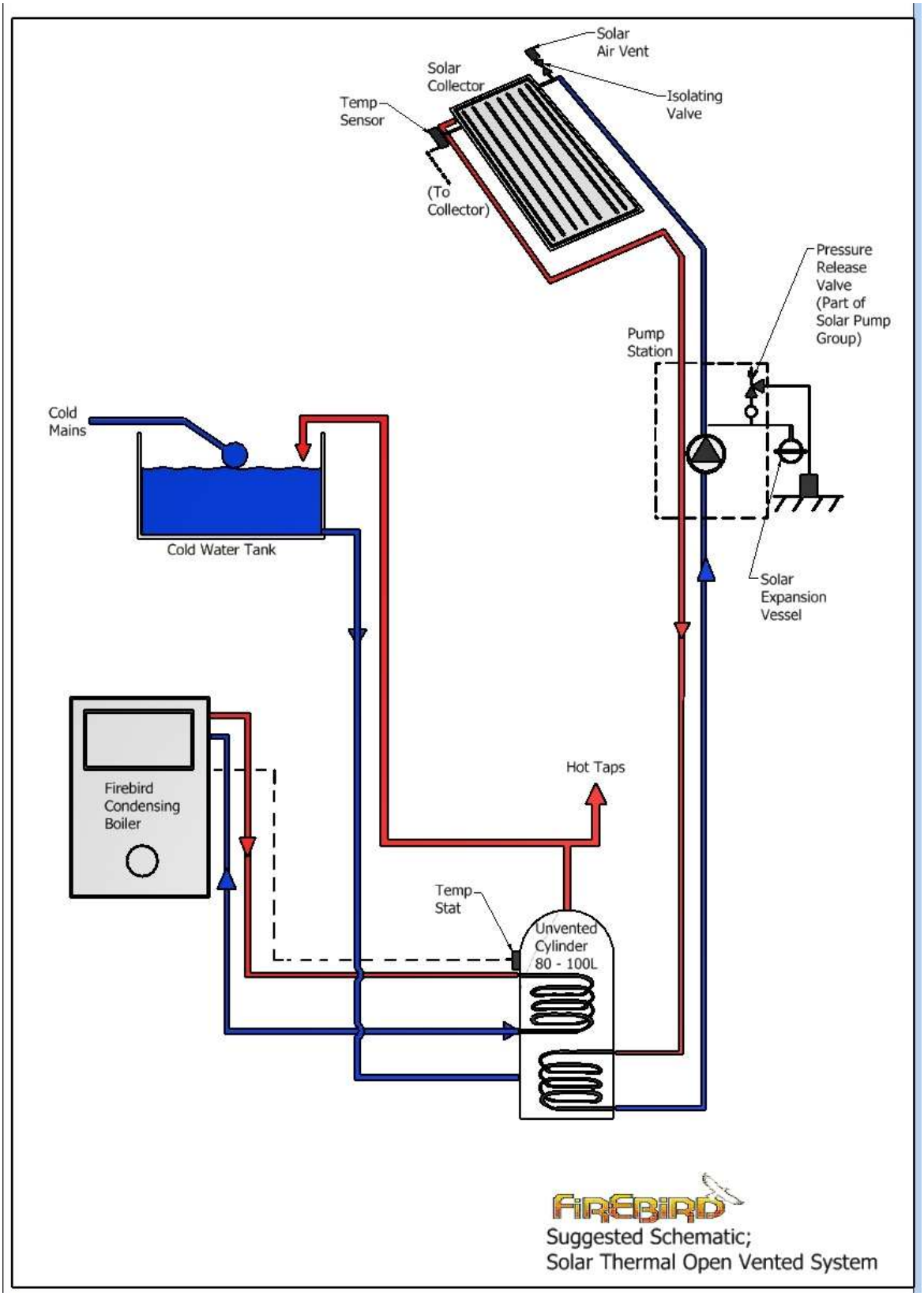
- Pressurised system with twin coil storage tank
- Open vented system with twin coil storage tank
- Solar thermal linked with a Firebird Combi boiler

Please Note:
The following system schematics are concept designs and are only intended as a guide to installers. They are **NOT** full system design drawings. Installers must always calculate and design the system requirements for each individual installation.

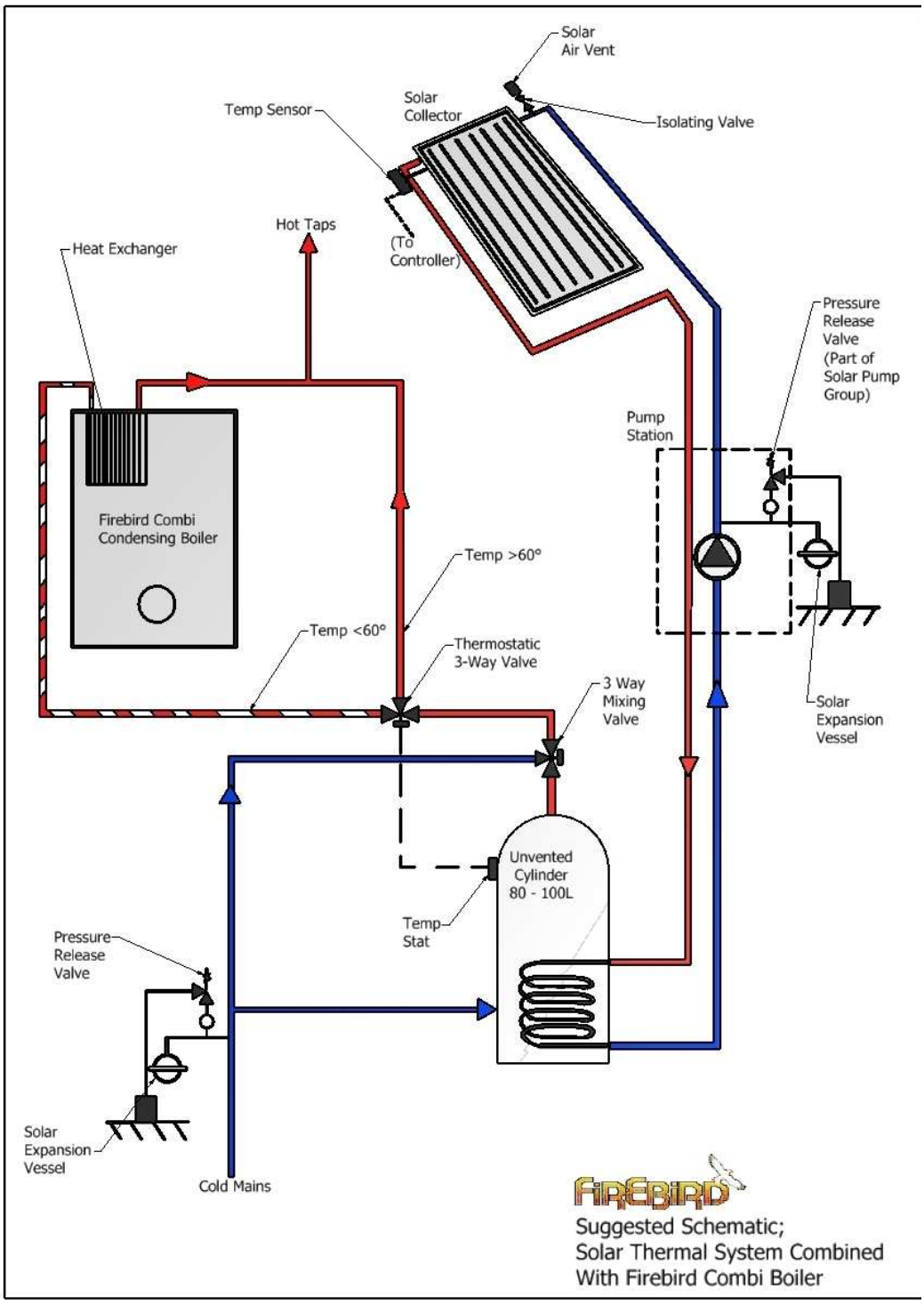
Un-vented (pressurised) System



Open Vented System



Solar Preheat to a
Firebird Combi Boiler with mechanical flow switch only



NOTE: The above concept is for a Firebird Combi boiler with mechanical flow switch. For any other Combi boiler make or model the installer must always check with the Combi boiler manufacturer for a recommended solar system design

E3. System Sizing

When sizing a system for the Ireland/ UK climate, an estimate for the collector surface area can be made under the following assumptions.

- The daily hot water use is between 35-65 litres (45^{o}C) per person.
- Desired solar fraction approximately 60%.
- Collector orientated between SE an SW.
- Collector pitched between 40^{o} and 50^{o}.
- Little or no shading on collector.

Size of Collector Array

The design goal is to cover the hot water load almost completely in the months with high irradiation (summer time). As a rule of thumb approximately 1 m^{2} of collector aperture area is required per person.

Solar Tank Size

A general recommendation is to have 50 litres of tank storage capacity for every m^{2} of collector aperture area. Typical tank sizes for Firebird solar collectors are shown in the table below;

No of Persons	Number of collectors	Tank Size (litres)
2-4	2 x CPK-7210N Flat panels 2 x CVSKC-10 Vacuum tubes 30 or 40 TZ58 Heat Pipes	200
5-6	3 x CPK-7210N Flat panels 3 x CVSKC-10 Vacuum tubes 50 or 60 TZ58 Heat Pipes	300

F. INSTALLATION

Make sure you have read the health and safety and pre-installation checks outlined in section D.

Before commencing any site work determine the best roof location for the solar collectors and decide where tank and other large components are to be located. When installing a Firebird solar system we would suggest the following order of installation, although it is not mandatory;

1. Install roof mounting fixtures and collectors* on roof or support structure
2. Run piping from panels down through roof structure and installed air vent and isolating valve
3. Insert temperature sensor into last collector on the flow side
4. Locate and install solar tank
5. Install pump station
6. Wire Solar controller
7. Complete all pipe work on the solar circuit and back-up heating circuit using
8. any components provided by Firebird such as air vent, anti-scald mixing valve, etc
9. complete all electrical connections including collector sensor

* TZ58 heat pipes should only be installed after the system has been commissioned

NOTE:

Detailed installation instructions are supplied with most solar system components. Please refer to these when installing the respective component.

Should you require any of these instructions prior to installation they can be downloaded from the Firebird website.

F1. Installing Solar Collectors

Installing Mounting Fixtures

Up to three different options are available for installing Firebird solar collectors;

- On-roof installation (pitched roof)
- On a flat roof ort surface
- In-roof installation (Flat panels only)

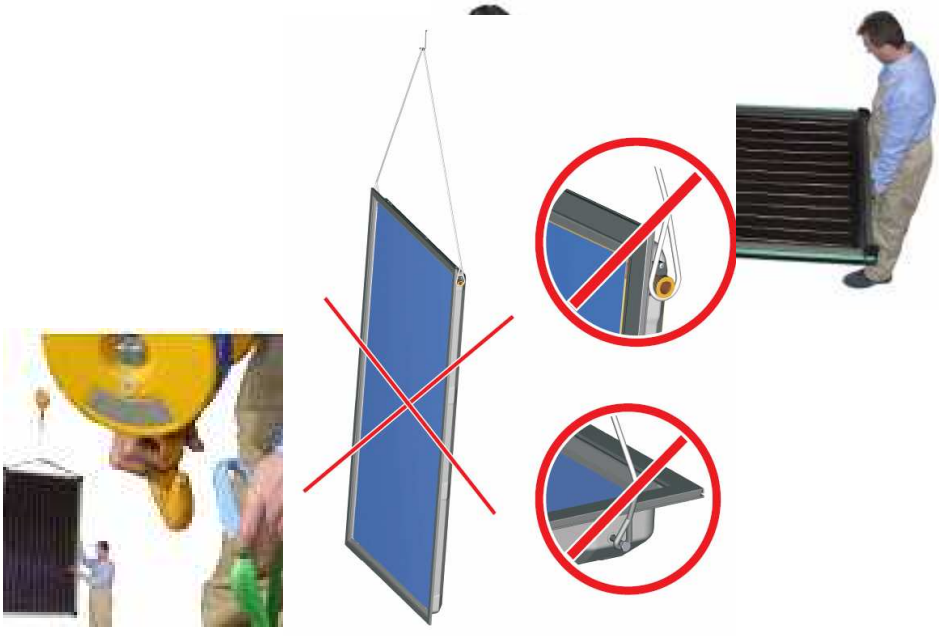


Full assembly instructions can be found in the manual provided with the mounting fixture kit.

Lifting collectors into place

By their nature solar collectors are heavy and difficult to lift so always make sure that you have suitable lifting equipment and safety harnesses. Please note the following;

- Never lift the collectors by the connections or the screw threads!
- A special kit is available for carrying and lifting flat plate collectors. Please contact the Firebird Sales office for more details.
- Do not expose the collectors to direct sunlight until the installation is complete. Firebird provide special weather proof covers if the panels are going to be left exposed for a long period before commissioning.
- The TZ58 heat pipes should only be installed after the system has been commissioned



Connecting Solar Collectors in Series

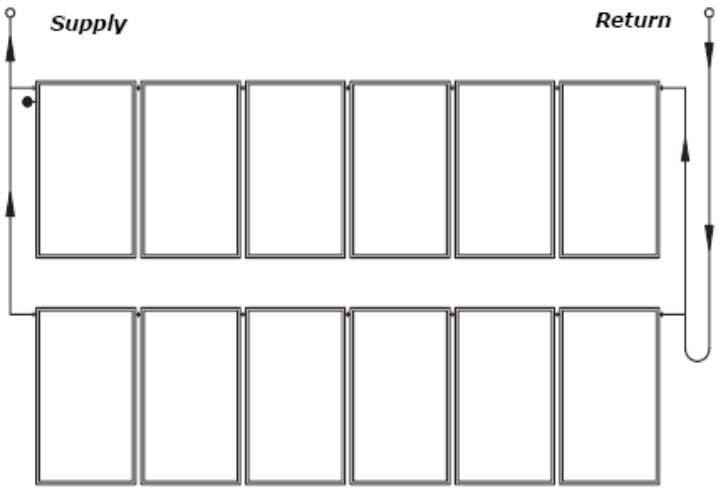
All Firebird Solar collectors can be joined in series.

The Flat Panel, CPK-7210N and U-Pipe Vacuum Tube, CVSKC-10 have male and female connectors at each end to facilitate interconnection A special gasket is provided with each collector to seal the connection.
When tightening the connections, always apply counter-pressure with a wrench or another spanner to prevent damage to the absorber.

The TZ58-1800 Heat Pipe Tubes have ¾“ male fittings on both sides so a special connector is required to connect the manifolds together

Collectors can be connected in series up to a maximum of

- **Six** collectors in series for the Flat Panel, CPK-7210N
- **Eight** collectors in the case of the U-Pipe Vacuum Tube, CVSKC-10
- and up to a total of **100 tubes** for the TZ58-1800 Heat pipes



As shown the diagram right we recommend that a ‘Reverse Return System’ be used when arranging banks of collectors onto a solar system. This type of arrangement ensures the length of the flow pipe work to the collector is equal to the length of the return pipe work, creating hydraulic balancing without the need for regulating valves.

F2. Connecting Flow/return pipes to Collectors

Every Firebird solar kit includes two stainless steel flexi pipes with suitable adapters for connecting to the solar collector. These flexi pipe save the installer having to make complicated pipe bends through the roof of the house.

When passing the pipes through the roof structure suitable flashing material must be used. The installer must ensure that a weatherproof seal is made between the pipes, flashing and roof.

Firebird supply pipe flashings for tiled and slate roofs as an optional accessory.

NOTE: External pipe work and insulation must stand up to environmental degradation such as air pollution, UV radiation, birds, rain, snow, etc.

F3. Installing the Temperature Sensor

The temperature sensor should be installed in the sensor sleeve nearest to the collector array flow. If the cable needs to be extend use a 2 core cable of each least 1mm² diameter.

To ensure optimal contact between the sensor and the surrounding environment, the gap between the sensor sleeve and the sensor element should be filled with a suitable conducting compound. All materials used for installing temperature sensors (sensors element, conducting compound, cables, sealing and insulating materials) must be suitably temperature resistant up to 250℃.

F4. Solar Water Storage Cylinders

Firebird offer a range of solar twin coil unvented cylinders that have been designed specifically for solar applications. A special open vented triple coil cylinder is also available.

Unlike some other 'dual coil' cylinders Firebird Solar cylinders have a purpose designed solar heating coil at the base of the cylinder, which ensures maximum heat input and efficiency from the solar energy while the back-up heating system (boiler) will heat the hot water via the upper coil. The cylinder is fitted with bosses to accommodate solar sensor pockets to enable correct heat control on the solar system.

The solar tank should be sized according to the size of the solar collectors used – see section E.

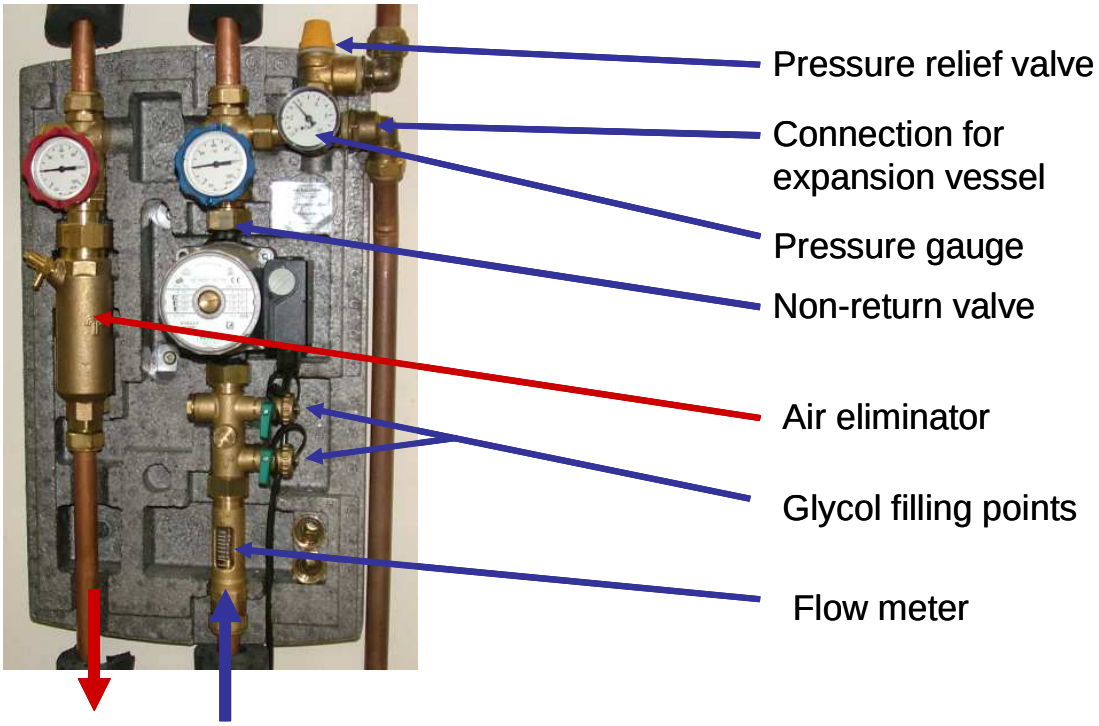
Some key features of the Envirosol solar tank range are:

- Premium stainless steel design for longer life and optimum hygienic conditions
- Efficient thermal insulation. 50mm Polyurethane foam is factory-injected between the cylinder and its outer skin.
- Easy-clean white finish ensures professional appearance
- All connections marked for ease of install.
- Usual cylinder accessories supplied as standard such as temperature and pressure relief valve, tundish, expansion vessel, etc.
- Immersion heater supplied with all cylinder

Full details on tank connections and installation are provided in the manual supplied with the tank

F5. Installing the Solar Pump Station

The Firebird Envirosol solar system is managed by a twin-line solar pump station and integrated solar controller. The pump station comes with a solar circulating pump with a 6m head, and contains the most important functional and safety components required for a solar system, namely:



- Dial thermometers for monitoring flow and return temperatures
- De-aerator with manual release valve
- Non-return valves on flow and return lines
- flow meter to set system flow-rate
- Fill/drain valve for filling and flushing the system
- Pressure relief valve
- Pressure gauge
- Connection for expansion vessel
- Wall mounting bracket with screws and dowels

Following connections need to be made to the solar pump station;

- flow and return lines linking the solar collector and storage tank
- expansion vessel connection. An optional kit is available which includes a flexi pipe, wall bracket and check valve

- connect discharge from pressure relief valve to suitable drainage container so that the householder is aware that solar fluid has been lost and how much was lost.

Non-Return Valves

Two non-return valves are included in the pump station (integrated into the thermometer ball valves) to ensure that no reverse flow occurs in the system when the water in the storage cylinder is hotter than that in the panels (e.g. at night)

Flow Meter

Flow rate is adjusted by turning the screw. Recommended flow rates are given in the commissioning section

F6. Solar Controller

The solar controller includes a differential temperature controller which monitors the temperature difference between the water in the bottom of the storage tank and the fluid in the solar collectors. When the fluid in the collectors is 6°C (factory set) warmer than the coolest water in the storage tank, there is usable heat to be collected. The controller starts the pump. When the temperature difference drops to within 4°C (factory set), the controller stops the pump. The pump remains off until a useful temperature difference exists again. The user can change the factory settings for starting and stopping the pump.

The controller is operated by 3 pushbuttons.

- The top right scrolls forward through the options
- The top left button scrolls back
- The button in the lower centre is the SET command, for when you want to make a change to any of the factory set values

Wiring Solar Controller

First slide down the plastic protection cover to reveal the controller. To access the electrical connection wiring terminals, remove the white lower plastic cover, one screw secures it to the body of the controller.

Power Supply connect on 19 (N) and 20 (L) - Earth on 12, and should be the last step of installation. The controller requires 240V / 50Hz power supply, fused at 5 amps.

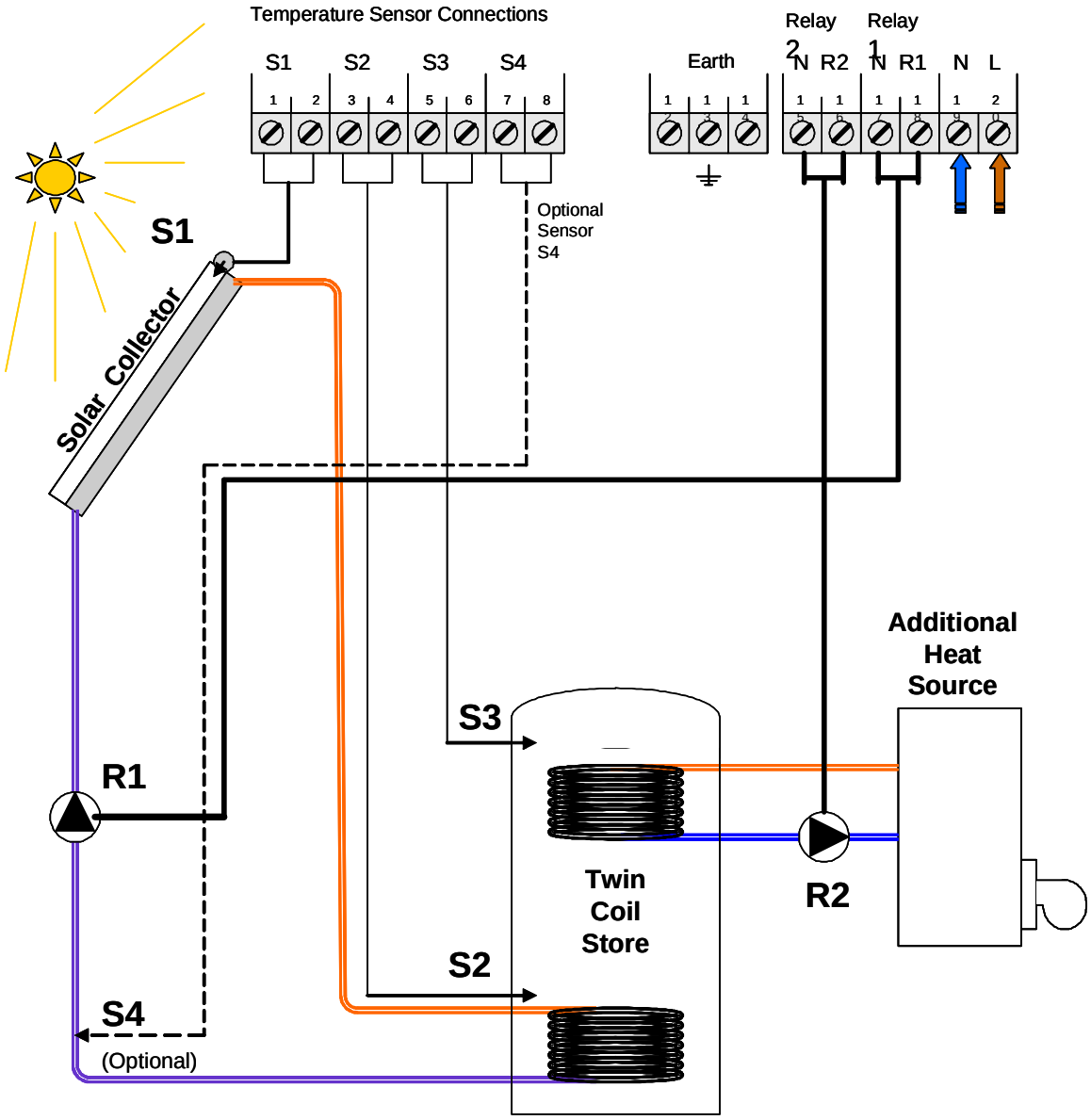
A layout of the controller connections is shown overleaf. Terminal connections for temperature sensor probes are on the left hand side as follows:

S1 - Solar collector temperature
S2 - Lower tank temperature
S3 - Upper tank temperature
S4 - optional for return temperature

Relay switch connections are on the right hand side:

R1 - Solar circulating pump (pre-wired)
R2 - Back-up heating circuit

Solar Controller Connections



Controller Settings

The Firebird solar controller is factory-set and there should be little need to change system settings. Factory settings for key parameters are;

Parameter	Description	Factory setting
DT 0	Switch ON temp. differential	6 ^{o}C
DT F	Switch OFF temp. differential	4 ^{o}C
S Mx	Maximum store temperature	60 ^{o}C
AH 0	Switch ON temperature for back-up heat source, i.e. boiler (based on upper tank temp. S3)	40 ^{o}C
AH F	Switch OFF temperature for back-up heat source, i.e. boiler	45 ^{o}C

F7. Install other System Components

Expansion vessel

As with any sealed system, the pumped circulation solar system has to have an expansion capability to cope with fluid expanding as the temperature increases. A suitably sized expansion vessel must be selected which is large enough to accommodate the content of the collector when steam forms (stagnation), this is to ensure that no heat transfer medium can escape from the safety valve.

NOTE: Before filling the system, the gas side (air or nitrogen) of the expansion vessel must be charged approximately 0.2 bar lower than the intended cold fill pressure (normally 2 bar) of the solar system. As the initial cold filling pressure is set slightly higher than the vessel gas pressure; some fluid is pushed in to the vessel. This provides an allowance for fluid losses between maintenance cycles and protects the expansion vessel membrane from potential jets of steam during the operational phases.

Air Vent / Isolating Valve

An automatic air vent is fitted at the highest point in the system. In most systems this is on the roof at the point where the flow pipe leaves the panels. In systems with more than one bank of collectors an air vent should be fitted to each bank. An isolating valve should be fitted before the air vent isolated once the system has been commissioned

Anti-Scald Mixing Valve

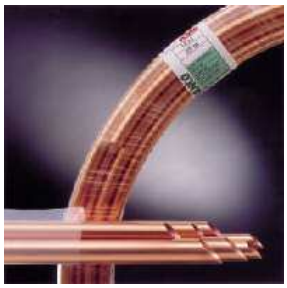
An anti-scald (mixing) valve must be fitted close to the hot water outlet of the solar tank so that delivery to the taps does not exceed 65℃

Solar Anti-freeze Fluid

Due to the high temperatures involved and the fact that some of the solar circuit piping runs outside a special solar anti-freeze fluid is required. Firebird recommends Tyfocor L for flat plate collectors and Tyfocor LS for TZ58 heat pipes and U-Pipe vacuum tubes.

F8. Pipe work & Insulation

Recommended Piping



Since high temperatures are involved only **copper** or **stainless steel** piping should be used. Never use plastic PEX pipes, ALU-PEX pipes or galvanized pipes in a solar system installation

Suitable Methods of Joining

Suitable joint types for solar circuits are

- Compression fittings
- Press fittings (gasket temperature resistance must be higher than 150^{o}C)
- Brazed fittings (hard solder)

Note: The use soft solder fittings (solder ring fittings) on copper pipe work is not recommended. Only use solar quality O rings if you are using press fittings

Pipe Sizing

The pipe size should be chosen to give the required flow rate in the system at the recommended flow velocity. Flow velocities of the order of 1m/sec are recommenced and should not exceed 1.5m/sec. Higher flow velocities will only result in extra noise levels.

The table below shows recommended pipe sizing for copper and stainless steel pipe work installations. Pipe runs (distance between the cylinder and the collector) should be kept as short as possible; under 5m is ideal. Minor heat losses will occur at distances above this.

Recommended Pipe Diameters

	Copper			**Stainless Steel**		
	Distance from cylinder to Collector			Distance from cylinder to Collector		
Collector Size	> 5m	> 10m	> 20m	> 5m	> 10m	> 20m
> 5 m2	12mm	15mm	18mm	16mm	20mm	20mm
> 8 m2	15mm	18mm	22mm	16mm	20mm	
> 12 m2	18mm	22mm	25mm	20mm		
> 25 m2	22mm	25mm	25mm	20mm		

Insulation

Insulation must be capable of withstanding temperatures in excess of 200℃, as temperatures of up to 200ºC are possible near the collector and at least 120ºC away from the collector.

The total solar loop must be insulated either with mineral wool pipe insulation or with rubber insulation such as HT/Armaflex.

Please note following in relation to solar pipe insulation;

- Avoid leaving pipes or connections un-insulated except for the spur line to expansion vessel.
- For outdoor pipe work the insulation must stand up to environmental degradation (air pollution, UV radiation, rain, snow, etc.) and degradation by animals (birds, mice, etc.) To prevent moistening, the insulation should be made of a closed-cell material (sealed porosity);
- Where possible, outdoor pipe work should be laid in a sheltered position
- The commissioning of a solar water heating system should be performed before the insulation is fitted to the pipe work.

G. COMMISSIONING

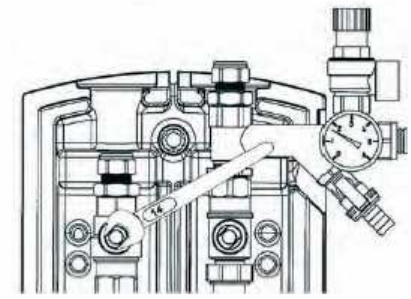
NOTE: The solar system should be filled and commissioned as soon as possible after installation to avoid any unnecessary heat build up in the collectors. If there is a delay with the commissioning of the solar system make sure that the collectors are covered with a suitable weather and UV-proof cover.

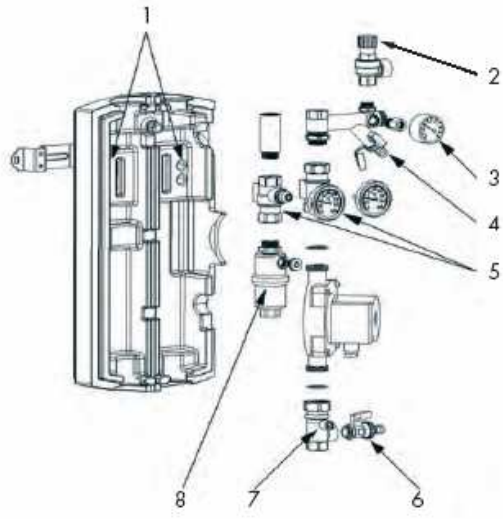
G1. Filling the Solar Circuit

First perform an air pressure test to check for leaks before proceed to fill the solar circuit.

Using a suitable filling system capable of delivering at least 5 bar pressure.

- Connect pressure hose from filling station to the upper filling valve and connect the flushing hose to the upper flushing valve. Open both valves.
- Using a slotted head screwdriver, close the restrictor in the flow regulating valve.
- Both non-return valves **must be opened** for filling, draining and flushing the system. Half opening the ball valves (ball valve has to be put in a 45° position) using a 14mm across flats spanner will open the non return valves
- Fill the container of the filling station with sufficient solar fluid for the system.
- Using filling station, fill the solar circuit and then flush for approx. 15 minutes.
- When the filling pump is running, close the flushing valve and set the system pressure to around 4 bar
- When the pressure is reached, close the filling valve and immediately switch off the filling pump. Check that the device is leak-free. If the manometer shows a significant drop in pressure, this points to a leakage in the system
- Re-open the flow regulating valve and switch on the circulating pump (control position “manual”) to the highest pumping level (III) and allow it to circulate for at least 15 minutes
- Bleed circulating pump by loosening the brass screw on the face
- Switch off pump and then bleed the system using the manual release valve on the de-aerator until the heat transfer fluid begins to escape.





- Set the operating pressure to 2 bar by carefully opening the flushing valve and releasing the heat transfer fluid into the container of the filling station
- Remove the hoses from the filling station and screw the caps on to the filling and flushing valves and (release the flushing valve first, then the filling valve)

G2. Bleeding the Solar Circuit

The system must be bled:

- On commissioning (after filling)
- Four weeks after commissioning
- When necessary, e.g. if there are malfunctions

G3. Setting Flow Rate

To ensure the optimum transfer of solar energy from the collectors to the storage tank the correct flow rate for the solar circuit needs to be used. Firebird recommends a flow rate of between 0.5 to 1.5 l/min per m2 of aperture.

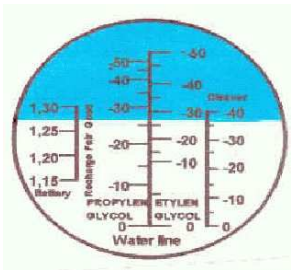
The flow rate can be seen on the flow meter on the return line of the pump station. To set the flow rate switch on the circulating pump (control position “manual”) and set the volume flow rate selecting the appropriate pump speed setting (I, II, III) and by using the restrictor slot on the flow regulating valve .

G4. Checking Frost Protection

The glycol anti-freeze supplied with a 40/60 glycol/water mix provides frost protection to as low as -25℃.

% Antifreeze	Protection to
25%	-12 ºC
30%	-16 ºC
35%	-20 ºC
40%	-25 ºC

The level of frost protection in solar system should be check annually using a refractometer (shown below) or other suitable device.



H. MAINTENANCE AND SERVICE

Firebird recommends that the following checks are undertaken annually on the solar system;

- Check solar circuit, tank and pump station for leaks
- Check solar system pressure. If it's dropped top up system with glycol anti-freeze and re-pressurise
- Inspect external pipe insulation for damage, degradation or contamination
- Visibly inspect solar collectors. Clean if your are in a dusty location using a sponge with a mild soap and water solution
- Inspect mounting fixtures for signs of damage and make sure all connections are tight.
- Test anti-freeze level of the glycol anti-freeze fluid and replace if necessary
- Check the charge pressure of all expansion vessels and reset if necessary
- Check circuit flow rate and adjust if necessary
- Check circulating pump for noise

I. FIREBIRD SOLAR WARRANTY

Firebird provides;

- 5 years warranty on the solar collectors - flat plate and vacuum tube – from date of purchase and
- 2 years warranty on all other solar system components from date of purchase

The warranty claims are subject to following conditions:

- All claims must be made within the above stated time limits
- The solar system must be installed in accordance with the Firebird installation instructions and all relevant standards and codes of practice.
- The solar system must be commissioned by qualified person(s)
- The Firebird warranty commissioning card must have been completed and return to the Firebird service department immediately after the system is commissioned
- Firebird can not accept liability in respect of any defect arising from incorrect installation, negligence, fair wear and tear, misuse, alteration or repair by unqualified persons.
- Firebird's prior authorisation must be obtained before examination or repair of any warranty part takes place.
- Firebird will investigate all warranty claims and for any claims that are deemed invalid, the costs incurred will not be borne by Firebird.

PLEASE COMPLETE & RETURN TO FIREBIRD SERVICE DEPARTMENT

COMMISSIONING CARD – SOLAR SYSTEM

HOUSEOWNER DETAILS **INSTALLER DETAILS**

Name …….. Name ……..

Address …….. Address ……..……..

……..

……..

Postcode: ……. Tel: ……. Postcode: …….Tel:.....

Accreditation

No……..

Collectors:

Type …… No of collectors……

Serial numbers……

Orientation ……

Solar Circuit:

System checked for leaks yes / no Pipe size …… (in mm)

Pressure …….. (in bars) Flow rate……(litres/min)

Anti-freeze protection to ……(in ºC) Expansion vessel size ……(litres/min)

Tank & Controller:

Tank type & model …… Tank capacity ……

litres

Mixing valve set at …… Sensors connected yes / no

Other:

Back-up water heating system ……..

Customer trained in use of system yes / no

System documentation handed over to customer yes / no

Signature of commissioning agent: ……

Date commissioned: ……

I confirm that I have received instructions on the operation of the Firebird Envirosol solar system and that I have been left a complete set of operation manuals by the commissioning agent.

Signed by houseowner/occupier; ……

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