NSAI Agrément

IRISH AGRÉMENT BOARD
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Firebird Envirosol Solar Heating Systems

Le système solaire de chauffage
Solarheizungssystem

NSAI Agrément (Irish Agrément Board) is designated by Government to issue European Technical Approvals.

NSAI Agrément Certificates establish proof that the certified products are **'proper materials'** suitable for their intended use under Irish site conditions, and in accordance with the **Building Regulations 1997 and subsequent revisions.**

PRODUCT DESCRIPTION:
This Certificate relates to the following Firebird Envirosol Solar Heating Systems:

- Firebird CPK-7210N Flat Plate Solar Collector
- Firebird CV-SKC10 Vacuum Tube Solar Collector
- Firebird TZ58-1800 Heat Pipe Solar Collector

Each system is comprised of a solar collector a cylinder, pump station, control panel, expansion vessel, connections, sloping roof kit, antifreeze, user & installation manual and labelling packs.

The Firebird CPK-7210N Flat Plate Solar Collector (for On/In Roof) consists of an aluminium housing/frame flat plate array, with powder coated aluminium flashing for in-roof applications.

The Firebird CV-SKC10 Vacuum Tube Solar Collector consists of an insulated manifold and a row of evacuated solar tubes incorporating direct flow technology for on-roof applications.

The Firebird TZ58-1800 Heat Pipe Solar Collector consists of an insulated manifold and a row of evacuated solar tubes incorporating a Heat Pipe technology for on-roof applications.

USE:
The Firebird Envirosol Solar Heating Systems can be used in new and existing buildings with a roof pitch of between 25° and 70°. The collector must be fixed to a roof that meets the requirements of SR 82:2017: *Irish code of practice – Slating and Tiling*, and prior versions of this document or previous Irish codes of practice for slating and tiling.

In addition, all relevant aspects related to the fixing of the PV panel to the roof structure shall be designed and installed to comply with SR 50-2:2012: *Code of practice for building services – Part 2: Thermal solar systems*.

The Firebird Envirosol Solar Heating Systems should be installed by competent persons with suitable training (including system specific training by the Certificate holder) and practical experience of the systems, and who have been approved by Firebird Boilers and NSAI Agrément to install the system.

MARKETING, DESIGN AND MANUFACTURE:
The Firebird CPK7210N Flat Plate and CV-SKC10 Vacuum Tube Solar Collectors are designed, manufactured and tested by GREENoneTEC Solarindustrie GmbH, Austria, and the Firebird TZ58-1800 Heat Pipe Solar Collectors are designed, manufactured and tested by Sunrain, China. The solar kits are designed and distributed by:

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1.1 ASSESSMENT

In the opinion of NSAI Agrément, the Firebird Envirosol Solar Heating Systems, if used in accordance with this Certificate can meet the requirements of the Irish Building Regulations 1997 and subsequent revisions, as indicated in Section 1.2 of this Agrément Certificate.

1.2 BUILDING REGULATIONS

REQUIREMENTS:

Part D – Materials and Workmanship
D3 – Proper Materials
The Firebird Envirosol Solar Heating Systems, as certified in this Certificate, are comprised of 'proper materials' fit for their intended use (see Part 4 of this Certificate).

D1 – Materials & Workmanship
The Firebird Envirosol Solar Heating Systems, as certified in this Certificate, meet the requirements for workmanship.

Part A - Structure
A1 – Loading
The Firebird Envirosol Solar Heating Systems, once appropriately designed and installed in accordance with this Certificate, have adequate strength and stability to meet the requirements of this Regulation (see Part 3 of this Certificate).

Part B – Fire Safety
Part B Vol 2 – Fire Safety
B4 & B9 – External Fire Spread
The Firebird Envirosol Solar Heating Systems will not affect the external fire rating of the roof structure on which they are installed (see Part 4 of this Certificate).

Part C – Site Preparation and Resistance to Moisture
C4 – Resistance to Weather and Ground Moisture
The Firebird Envirosol Solar Heating Systems, once appropriately designed and installed in accordance with this Certificate, will not affect a roof's resistance to the ingress of moisture (see Part 4 of this Certificate).

Part L – Conservation of Fuel and Energy
- Dwellings
- Buildings other than Dwellings

L1 – Conservation of Fuel and Energy
The Firebird Envirosol Solar Heating Systems can be designed to meet the minimum level of energy provision from renewable technologies stated in this Regulation (for domestic dwellings), i.e. 10kWh/m^2/annum contributing to energy use for domestic hot water heating.

2.1 PRODUCT DESCRIPTION

This Certificate relates to the following Firebird Envirosol Solar Heating Systems:

- Firebird CPK-7210N Flat Plate Solar Collector
- Firebird CV-SKC10 Vacuum Tube Solar Collector
- Firebird TZ58-1800 Heat Pipe Solar Collector

Each system is comprised of a solar collector a cylinder, pump station, control panel, expansion vessel, connections, sloping roof kit, antifreeze, user & installation manual and labelling packs.
Figure 4 shows the main elements of the Firebird Envirosol Solar Heating Systems.

The Firebird CPK-7210N Flat Plate Solar Collector consists of an aluminium frame flat plate array, with powder coated aluminium flashing for in-roof applications.

The Firebird CV-SKC10 Vacuum Tube Solar Collector consists of an insulated manifold and a row of evacuated solar tubes incorporating direct flow technology for on-roof applications.

The Firebird TZ58-1800 Heat Pipe Solar Collector consists of an insulated manifold and a row of evacuated solar tubes incorporating a Heat Pipe technology for on-roof applications.

The Firebird Envirosol Solar Heating Systems have been tested to EN 12975-2:2006 *Thermal solar systems and components – Solar collectors – Test methods*

2.1.1 Firebird CPK7210N Flat Plate Solar Collector

The Firebird CPK7210N Flat Plate Solar Collector contains an absorber plate made of copper and coated with a selective TiNOX absorber coating. A double parallel array of copper tubes are ultrasonically welded to the back of the absorber plate. The Absorber assembly is encased in an aluminium housing complete with 40mm mineral wool (Rockwool) insulation (λ = 0.045W/mK) on the back of the absorber to protect the heat collected from heat loss. A 3.2mm thick sheet of toughened glass covers the collector to reduce convection losses and provide the necessary protection to the absorber. See Figure 1.

The solar system solution is pumped through the absorber where it receives energy and is then transferred to the solar coil integrated in the solar storage vessel.

Up to a maximum of 6 collectors can be joined together in series with a minimum flow rate of 6 litres/minute.

Firebird CPK7210N Flat Plate Solar Collectors are suitable for use in On-roof and In-roof applications.

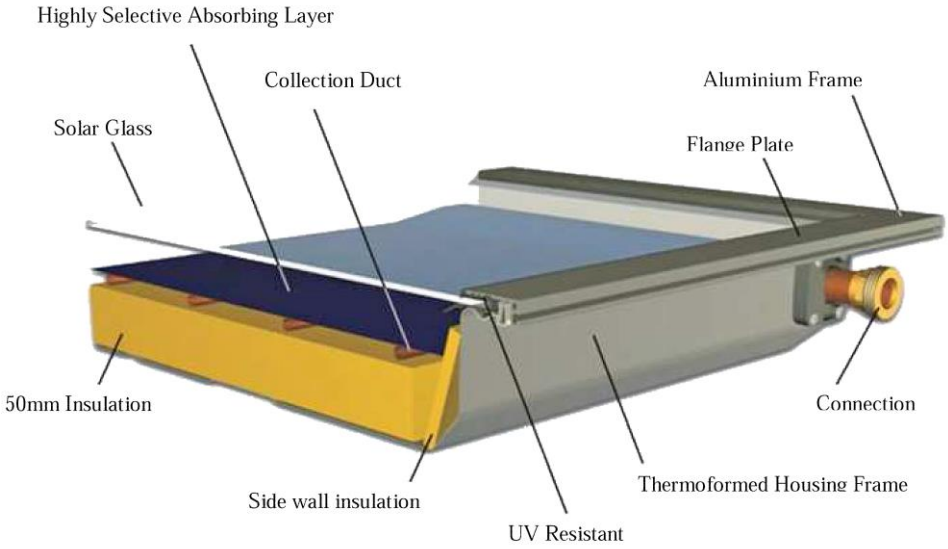


Figure 1: Firebird CPK7210N Flat Plate Solar Collector

2.1.2 Firebird CV-SKC10 Vacuum Tube Solar Collector

The Firebird CV-SKC10 Vacuum Tube Solar Collector utilises a U-pipe direct flow system which is contained in a double walled evacuated tube (Sydney tube). The heat transfer fluid flows inside a U-shaped pipe within the inner tube (absorber) of each solar tube. Each Sydney Tube consists of two glass tubes made from 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 converts solar energy into heat energy and transfer heat to the copper U-tube by means of a close-fitting aluminium plate. 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 losses.

The efficiency of the Firebird CV-SKC10 Vacuum Tube Solar Collector is increased by including a highly reflective weatherproof CPC mirror (Compound Parabolic Concentrator) behind the evacuated tubes, to ensure 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). See Figure 2.

The solar system solution circulated through the U-tube is heated and transfers the heat energy to the solar coil integrated in the solar storage vessel.

Up to a maximum of 8 collectors can be joined together in series with a minimum flow rate of 6 litres/minute.

Firebird CV-SKC10 Vacuum Tube Solar Collectors are suitable for use in On-roof applications.

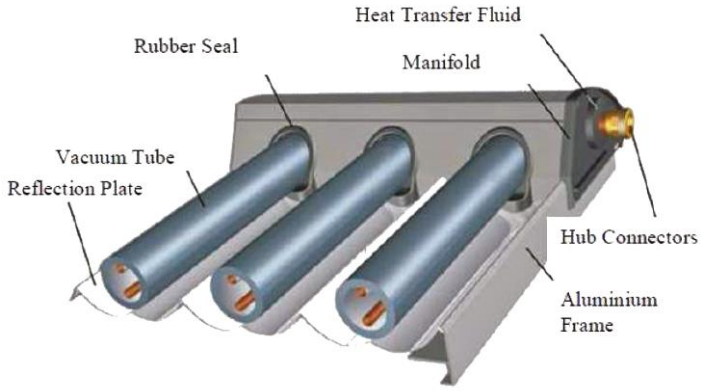


Figure 2: Firebird CV-SKC10 Vacuum Tube Solar Collector

2.1.3 Firebird TZ58-1800 Heat Pipe Solar Collector

The Firebird TZ58-1800 Heat Pipe Solar Collectors consists of an array of evacuated 'Sydney Tubes' which house the heat pipes and absorbers. Evaporator fluid is contained within the heat pipe. The energy absorbed by the absorber causes the fluid to change from a fluid state to a vapour state and the vapour rises to the condenser bulb.
The condenser is connected directly into the manifold via a dry pocket. Within the manifold, the solar system solution is passed across the dry pocket that houses the condenser. The condenser releases the latent heat of evaporation to the solar system solution and condenses. The condensate returns to the heat pipe and the cycle is repeated.

Due to the dry connection, Firebird TZ58-1800 Heat Pipe Solar tubes can be replaced without the need of draining down the solar system.

Up to a maximum of 100 tube collectors can be joined together in series with a flow rate of 12 litres/minute.

The Firebird TZ58-1800 Heat Pipe Solar Collectors are suitable for use in On-roof applications.

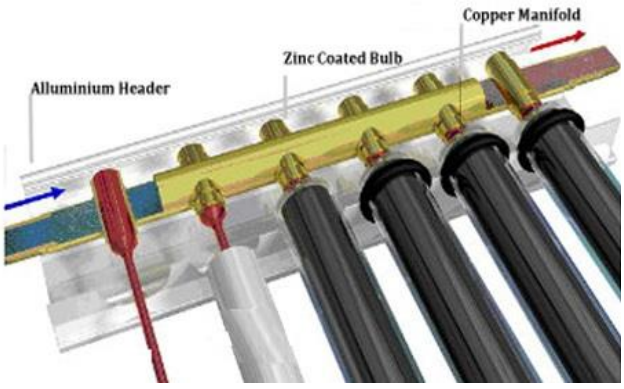


Figure 3: Firebird TZ58-1800 Heat Pipe Solar Collector

2.2 MANUFACTURE

2.2.1 The Firebird CPK-7210N Flat Plate Solar Collector and CV-SKC10 Vacuum Tube Solar Collector are designed, manufactured and tested at the GREENoneTEC facility in Austria.

The management systems of GREENoneTEC have been assessed and registered as meeting the requirements of ISO9001:2000. GREENoneTEC are also registered as meeting the requirements of ISO 14001.

Under conditions set out by the Solar Keymark Certification, GREENoneTEC are registered and bi-annually monitored by ITW .

Manufacture of the Firebird CPK-7210N Flat Plate Solar Collector consists of fabrication of the absorber panel and assembly with aluminium deep pressed housing, insulation, glass and seals to provide silicon free and dry-sealed unit.

Manufacturer of the Firebird CV-SKC10 Vacuum Tube Solar Collector consists of manufacture and assembly of the u-tube pipework into the insulated aluminium manifold, and assembly with the frame housing, Sydney tubes and cylindrical aluminium, absorber.

GREENoneTEC operate a 100% final inspection of their products. Quality control checks include measurement within tolerance, visual inspection during each stage of the assembly process and pressure testing of the absorber pipework to 15 bar.

2.2.2 The Firebird TZ58-1800 Heat Pipe Solar collectors are manufactured by Jiangsu Sunrain Solar Energy Co. Ltd. in China. The management systems of Sunrain have been assessed and registered as meeting the requirements of ISO9001. Under conditions set out by the Solar Keymark Certification, Sunrain Solar Energy are registered and continuously monitored by Fraunhofer ISE, Germany. Manufacture consists of fabrication and assembly of the heat pipes, absorbers, manifolds and evacuated tubes.

Sunrain Solar Energy Co. Ltd. operate a 100% inspection of their products which include vacuum and stress testing of the evacuated tubes and pressure testing of the copper HP tubes and manifolds

The solar collector mounting frame is manufactured using profiled aluminium vertical and horizontal sections. The manifold is made from pressed aluminium. The header is insulated using polyurethane (PU) foam. The heat pipe condenser (bulb) 24mm diameter x 90mm length is nickel coated to prevent "welding" of heat pipe and heat pipe socket during high temperatures operation.

2.3 DELIVERY, STORAGE AND HANDLING

Firebird supply a full package for each solar heating system installation, which includes the collectors, cylinder, pump station, expansion vessel, connections, antifreeze, stainless steel pipework, connections, solar inhibitor – antifreeze, roof mounting kit, control panel, user & installation manual and labelling packs.

The follow guidelines should be followed when transporting and storing solar system components:

- Solar collectors should always be stored indoors.
- CPK-7210N Flat Plate Collectors can be transported and stored horizontally or vertically and can be stacked on top of each other (up to the manufacturer's prescribed limit of 10 units).
- CVSKC-10 U-Pipe Vacuum Tube should only be transported and stored in a vertical position.
- TZ58-1800 Heat Pipe Tubes should remain in their respective boxes in an upright position during transport and storage.
- Cylinders should be transported and stored vertically.
- All other solar system components should be stored in a clean, dry, frost free environment until ready for installation.
- Heavy goods should never be loaded on top of solar collectors or kit boxes.

Parts should be inspected for damage on arrival to site and any damages or losses should be reported to the Certificate holder. Care should be taken when opening kits to prevent scratches or sudden shocks to the collectors and sharp objects should not be used to open the packaging.

2.4 INSTALLATION

2.4.1 General

The Firebird Solar Collector Heating Systems should be installed by competent persons with suitable training and practical experience of the systems (including system specific training by the Certificate holder), who have been approved by Firebird and NSAI Agrément for this purpose. The installer shall fully understand the requirements of the customer and have completed a user and installation health & safety risk assessment.

The necessary plumbing work should be undertaken by a qualified plumber and the necessary electrical work required to install the control equipment, should be undertaken by a qualified RECI electrical contractor. Solar panel installations must be performed in accordance with all Health & Safety legislation and local building/planning regulations.

The solar collector must not be left exposed to solar radiation prior to filling or when the solar loop and manifold have been drained. Collectors left exposed in a dry state must be covered to prevent possible long term damage. The solar collector system should be commissioned in low light, or by covering the collector array, until it has cooled down to a safe working temperature; ideally in the morning when the solar loop should be coolest.

All Fixings and flashings used with the Clean Energy Ireland Solar Heating Systems must comply with SR 82:2017 and SR 50-2:2012.
All tiles adjacent to the collectors should be mechanically fixed in place.

In high wind load areas, identified during the initial assessment survey, the truss design should be checked by a Structural Engineer for suitability, in relation to the applicable point loads. Any resulting modification required shall form part of the Structural Design report and sign-off documentation issued by the Structural Engineer. This should be completed prior to commencement of work.

1	Heat Dump
2	DHW Cylinder
3	Temperature Stat
4	Relay 2
5	Solar Collector
6	Temperature Sensor
7	Pump Station
7A	Pressure Release Valve
7B	Solar Thermal Vessel
7C	Controller
8	Isolating Valve
9	Solar Air Vent
10	DHW Tank Sensor

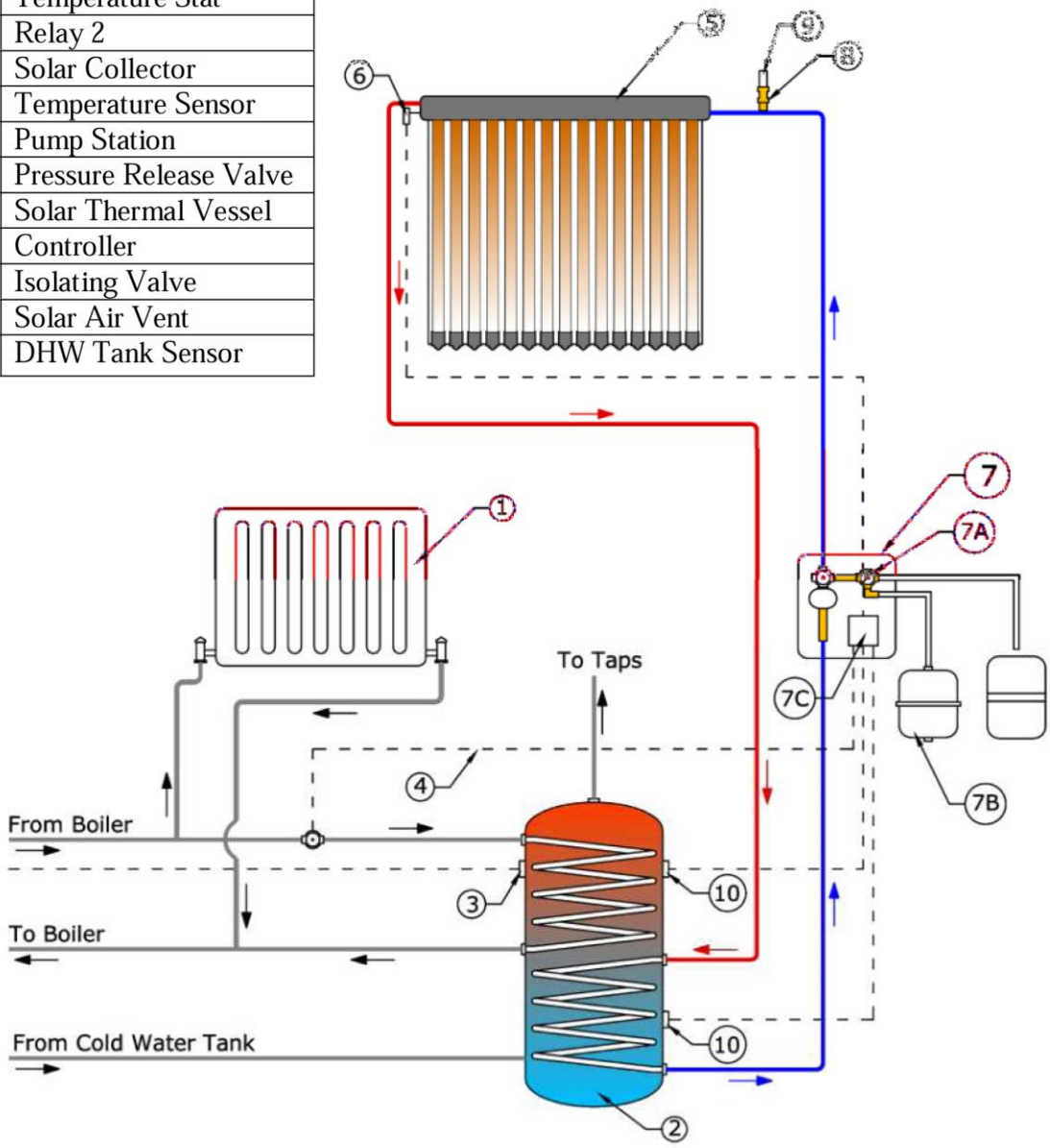


Figure 4: Main components of the Firebird Envirosol Solar Heating Systems

NSAI Agrément

Table 1:Characteristics of Firebird Envirosol Solar Collectors.			
	CPK-7210N	**CV-SKC10**	**TZ58-1800 2/**
Type	Flat Plate – on/in roof	Vacuum Tube	Heat Pipe
Dimensions	2038 x 1039 x 98 mm	1645 x 1115 x 107 mm	1.8mx0.058m Tube length x outer dia.
Height/Depth	94 mm	107 mm	189 mm
Gross Area	2.11 m^2	1.83 m^2	4.901m^2
Total Weight - empty	38 kg	31 kg	106kg approx.
Liquid Volume	1.4 litres	1.63 litres	2.3 litres
Flow rate	0.5 to 1.5 l/min per m^2 of aperture	0.5 to 1.5 l/min per m^2 of aperture	0.5 to 1.5 l/min per m^2 of aperture
Absorber shape	Flat Plate	Cylindrical	Cylindrical
Aperture Area	1.88 m^2	1.59 m^2	2.791m^2
Absorber Area	1.79 m^2	1.59 m^2	2.411 m^2
Absorption	95%	96%	94%
Emission	5%	6%	7%
Max Stagnation Temperature	197°C	286°C	200.3°C
Max Operating Pressure	10 bar	10 bar	10 bar
Efficiency Constants for G=8000W/m^2 (Aperture Area) 1/	η_0 = 0.741 a_1 (W/m^2K) = 3.705 a_2(W/m2K) =0.015	η_0 = 0.605 a_1 (W/m^2K) = 0.85 a_2(W/m2K) = 0.01	η_0 = 0.734 a_1 (W/m^2K) = 1.529 a_2(W/m2K) = 0.0166
Materials			
Casing/Manifold Material	Aluminium (pressed)	Aluminium (Extruded)	Aluminium (Extruded)
Absorber Material + Coating	Copper + Highly Selective	Glass/Aluminum + Selective Coating	Aluminium + ALN/SS-ALN/Cu
Flowed Through Element	Copper Pipe	Copper Pipe	Copper Pipe
Glazing / Thickness	Toughened Glass / 3.2mm	Borosilicate glass / 1.5mm (outer tube)	Borosilicate glass / 1.8mm (outer tube)
Insulation Material	40mm mineral wool	Mineral wool (40mm)	Mineral Wool (40mm)
Heat Transfer Fluid	Water-Propylene glycol mix	Water-Propylene glycol mix	Water-Propylene glycol mix

1/ η_0 (zero-loss collector efficiency), a_1 (heat loss coefficient), and a_2 (temperature dependence of heat loss coefficient values from tests carried out in accordance with I.S. EN 12795-2:2006 (I.S EN ISO 9806:2017)– ITW Test Report No. 07COL577OEM07 for the CPK-7210N Collector, ITW Report No. 04COL349OEM06 for the CV-SKC10 Collector and Fraunhofer Institute Test report :KTB Nr.2007-07-en for the TZ58-1800 collector

2/ Specified data based on largest collector in the Series – 30 tube set (TZ58-1800-30R)

Table 2:Power Output Per Collector Unit .									
T_m-T_a 1/	**Global Irradiance (G) 1/ 2/**								
	G = 400 W/m^2			**G = 700 W/m^2**			**G = 1,000 W/m^2**		
	CPK-7210N	**CV-SKC10**	**TZ58-1800**	**CPK-7210N**	**CV-SKC10**	**TZ58-1800**	**CPK-7210N**	**CV-SKC10**	**TZ58-1800**
10K	485	370	772	903	658	1387	1321	947	2001
30K	323	330	650	741	619	1264	1159	907	1879
50K	138	227	490	556	566	1105	974	855	1719

1/ G, T_m (mean temperature of system fluid), T_a (ambient temperature) and performance values per I.S. EN 12795-2:2006 (I.S EN ISO 9806:2017)– ITW Test Report No. 07COL577OEM07 for the CPK-7210N Collector (determined), ITW Report No. 04COL349OEM06 for the CV-SKC10 Collector (determined) and Fraunhofer Institute Test report :KTB Nr.2007-07-en for the TZ58-1800 collector

2/ Above values for the TZ58-1800 collector are based on output from the TZ58-1800-30R (30 tube set – Largest collector of series).

2.4.2 Pre-Installation

Sizing of the Solar Heating System

Minimising the risk of stagnation must be considered by the installer when sizing a solar heating system. The system must not be oversized, but must comply with the requirements of Part L of the Building Regulations. The following steps should be taken to correctly size a solar heating system:

- Determine the daily hot water demand.
- Calculate the hot water heat requirement.
- Calculate the storage volume.
- Size the required collector area.
- Size the system components.

Sizing of Safety Equipment

Component sizes are relative to the volume of liquid in the system and the Firebird Installation Guide to Solar Systems should be consulted for each system.

Risk Assessment

Before work commences on the installation, a risk assessment must be completed and recorded by the installer. Items assessed include:

- Access to roof.
- Ability of roof structure to accommodate all applied loadings.
- Working at height.
- Effects of wind and snow loads.
- High temperature pipe work and liquids.
- Antifreeze storage and discharge release.
- Water quality.
- Fire safety (installation of high temperature components).
- Risk of legionella.
- Access for routing pipework.
- Protection from overhead wires.

Site Survey

Following completion of the initial risk assessment, a site survey must be carried out by the installer. This survey will typically cover the following points:

- Identification of any special user requirements.
- Shading (current and potential risk).
- Suitability of roof (collector fixing surface, tile/slate condition etc).
- Roof orientation.
- Access to collector location.
- Pre-heat storage location- is there adequate space for DHW cylinder and solar control system)..
- Configuration of occupants DHW system and anticipated usage patterns.
- Sizing of the solar heating system.
- Location of and access to pump station assembly.
- Control panel location and fixing height.

2.4.3 Sloping Roof Kit

The Certificate holder defines the roof kit to be used, depending on the collector being installed and the type of slate/tile used. All roof brackets are manufactured from stainless steel. Isolation gaskets shall be used where necessary to ensure bi-metallic corrosion does not occur. The collectors and fixing bracket systems are designed to cover all Irish wind zones (as illustrated in Figure NA.1 in Irish National Annex to Eurocode 1). However, in high wind load areas, e.g. at excessive heights or very exposed areas, additional roof fixing brackets may be required. The advise of the Certificate holder shall be sought in all such instances, or if doubt exists. See Cl. 3.1 of this Certificate for details of the mechanical load and wind up-lift testing performed on the Firebird range of collectors.

The main contractor shall ensure that the roof, including any support system for the PV array, is designed and constructed to comply with the relevant technical specifications for the use of structural timber: I.S. EN 1995-1-1:2005 Eurocode 5. Fitting of both the in-roof and on-roof collectors requires the installation of additional structurally designed and adequately fixed timber reinforcing plants (not the existing roof structure) to meet the requirements of SR 50-2: 2012.

An assessment of the condition of the rafter timbers is part of the site survey report. Any timbers showing signs of damaged or rot must be replaced. In high wind load areas, identified during the initial assessment survey, the truss design should be checked by a Structural Engineer for suitability in relation to the applicable point loads. Any resulting modification required shall form part of the Structural design report and sign off documentation issued by the structural engineer. This should be completed prior to commencement of works.

2.4.4 Firebird CPK-7210N (Flat Plate) Solar Collector (CV-SKC10 Vacuum Tube) and TZ58-1800 (Heat Pipe) – On-roof Installation

The complete procedure for the installation of the Firebird range of on-roof collectors is detailed in the Firebird Installation Manual and must satisfy the requirements of SR 50-2: 2012.

The roof is measured to establish the collector or array position. In order to minimise suction force caused by wind loads, the distance between the outer edge of the roof and the collector should be 700mm (about 3 tiles). The distance from the roof ridge should be approximately 2 tile rows.

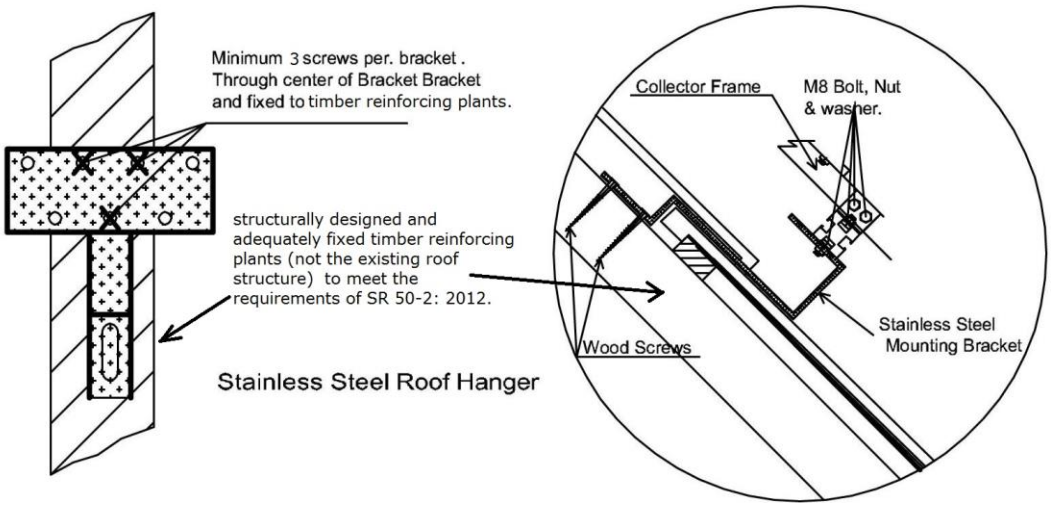


Figure 5: Fixing Detail

Location of Fixing Points

The line of the top and bottom profile on the roof is marked out using a chalk line and spirit level (approximately 132-183cm apart). The spacing between attachment points is identified (as defined in the Firebird Installation Manual) to ensure the stainless steel hook brackets (S-Bracket) supplied by the Certificate holder are located central to the timber reinforcing plants. These S-brackers are then fixed with self tapping screws. Minimum requirement of 2 no. 60mm x 4mm screws are to be used for each bracket fixing. Insert the tile over bracket, carrying out any necessary adjustments to the tile as required to ensure any resulting movement due to wind loads are not transferred to the tiles /slats. Refer to installation manual for detailed instructions and associated pictures.

Firebird TZ58-1800 Heat Pipe Collector

The complete procedure for the assembly and installation of the Firebird TZ58-1800 Heat Pipe Collector frame are detailed in the Firebird Installation Manual. The mounting frame for the TZ58-1800 collector is assembled on site and fixed directly to the installed roof fixings.

Firebird CSKC-10 Vacuum Tube Collector

The complete procedure for the installation of the Firebird CSKC-10 Vacuum Tube Collector is detailed in the Firebird Installation Manual. The Firebird CSKC-10 Vacuum Tube Collector comes pre-assembled. A maximum of 6 sets of collectors can be connected together in sequence.

Upper and lower support rails provided in the installation kit are aligned in the collector clamps and secured in position. Adjoining support rails are joined using a kit joining clamp with one rail supporting two panels.

Firebird CPK-7210N (Flat Plate Collector–On roof)

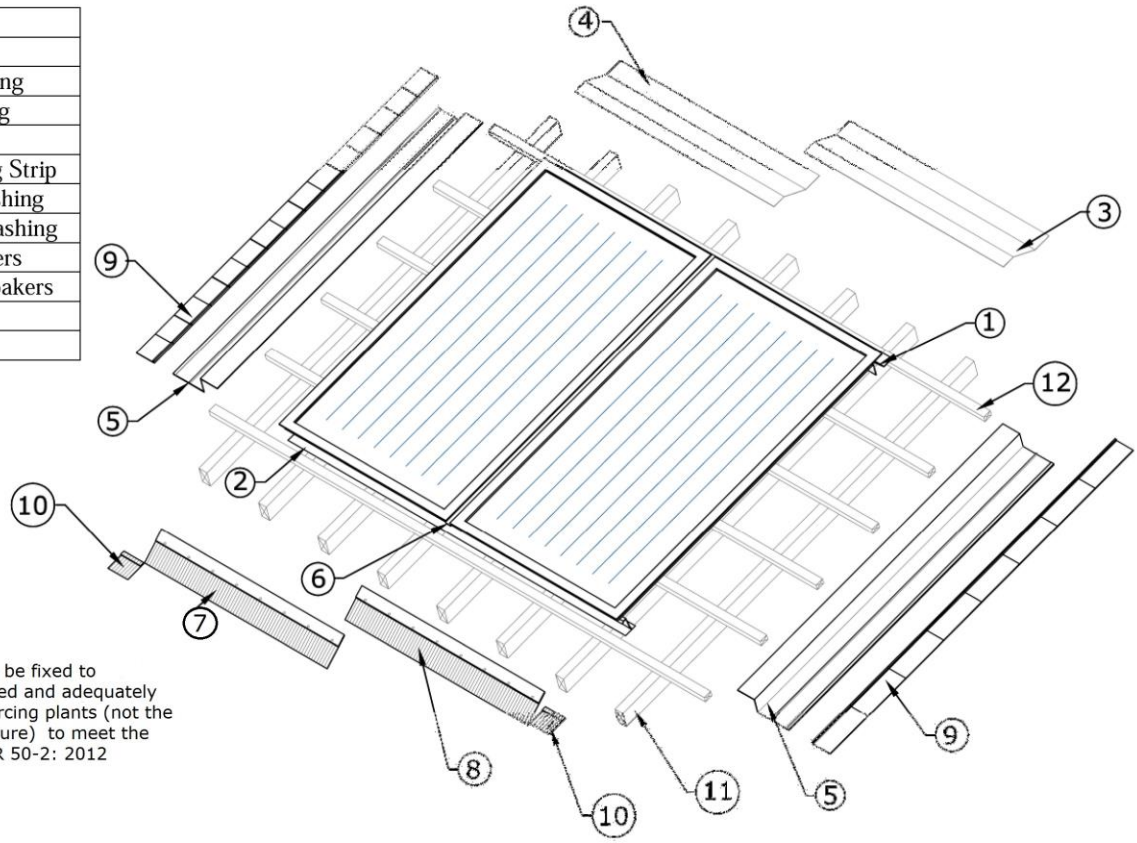
The complete procedure for the installation of the Firebird CPK-7210N Flat Panel is detailed in the Firebird Installation Manual. The Firebird CPK-7210N Flat Panel comes pre-assembled. A maximum of 8 sets of collectors can be connected together in sequence. The CPK-7210N collectors are fixed directly on to the upper and lower rails

2.4.5 Firebird CPK-7210N (Flat Plate) In-roof Installation

The complete procedure for the installation of the Firebird CPK-7210N collector is detailed in the Firebird Installation Manual. All relevant general instruction in Cl. 2.4.3 and 2.4.4 should be applied.

- The roof tiles/slates from the chosen area on the roof where the panel/s are to be placed are removed (including up to 1m each side of the panels). The upper part of the flashing should be at least 2 tile rows below the ridge.
- The Firebird CPK-7210N collector shall always be fixed directly into structurally designed and adequately fixed timber reinforcing plants (not the existing roof structure) to meet the requirements of SR 50-2: 2012.
- Stainless steel brackets supplied by the Certificate holder are then secured to these timber reinforcing plants.
- The upper and lower mounting rails are then installed and secured in place with the Kit nuts ensuring diagonal dimensions are correct.
- The collectors are then lifted into place and fixed loosely to the bottom rail. Lifting kit is available from the Certificate holder Connecting sockets should never be used for lifting purposes.
- The flow and return of adjoining collectors are then connected using the kit seals.
- The collectors are been aligned, maintaining a 22mm gap between them. The joining strip is inserted into the tracks on the sides of the outer frame of the panels and all fixing bolts are tightened.
- The collector sensor probe is then inserted into the tube housing (situated on the right hand side of the panel). and all pipe-work (inlet and outlet) is connected.
- Firebird offer Tile and Slate flashing kits with the Firebird CPK-7210N in-roof collectors to suit the roof covering in which the collectors are to be installed. These powder coated aluminium flashing kits, (for use on tiled or slated roofs with an inclination of more than 25º), provide a weatherproof connection between the roof tiles and the solar panels.

1	Top Rail
2	Bottom Rail
3	Top Right Flashing
4	Top Left Flashing
5	Side Flashings
6	Collector Joining Strip
7	Bottom Left Flashing
8	Bottom Right Flashing
9	Slate Roof Soakers
10	Flexible Roof Soakers
11	Roof Rafters
12	Slate Laths



Note:
In-roof collector to be fixed to structurally designed and adequately fixed timber reinforcing plants (not the existing roof structure) to meet the requirements of SR 50-2: 2012

Figure 6: Flashing detail

- Stainless steel plumb screws for fixing the flashings to the frame of the collector are supplied with the flashing kit. No additional lead, sealants or fixings are required. Full installation details of the Tile/Slate flashings (for single and multiple collector panels) are included in the Certificate holders installation manual. See Figure 5.

2.4.6 Roof Penetrations

The Certificate holder supplies the Glidevale G1 vent tile (See Figure 8) for use with the full range of Firebird on-roof collectors, for carrying pipes through the roof into the attic space. This vent tile is manufactured from ABS (Acrylonitrile Butadiene Styrene) and is AA fire rated when tested to BS 476-3:2004 *Fire tests on building materials and structures – Classification and method of test for external fire exposure to roofs*.

The vent tile will have a design life equivalent to the Firebird Solar Collector Heating System and must be inspected as part of routine maintenance on the system. Replacement of the Glidevale G1 vent tile will require draining and refilling the system.

Where pipes penetrate the interior of the attic space, e.g. through the roof underlay or plasterboard, for the Firebird on-roof and in-roof systems, all resulting penetrations must be sealed in accordance with the Certificate holders installation manual before completing the work.

When installed in accordance with the Certificate holder's instructions, this system creates a permanent seal which ensures the weather tightness of the external building envelope is maintained.

The Certificate holder provides a self-adhesive sealing collar (Product Code SOL050CLR) for sealing perforations in the underlay to facilitate pipe work.

Where existing insulation and/or plasterboard is displaced, it must be replaced with similar material and made airtight. The Certificate holder also recommends the Siga range of seals and tapes (NSAI Agrément Certificate 08/0314) to seal other perforations in the fabric of the building to maximise air tightness.

Figure 7: Sealing of the Roof Underlay using the Glidevale self adhesive sealing collar

Figure 8: Glidevale G1 Vent Tile

2.4.7 Connections

In any solar heating system, the 'return' refers to the intake in the collector where liquid is returning to be reheated. The 'flow' refers to the hot outflow side where the liquid is flowing to the heat exchanger. It is essential that the collector temperature sensor is located in the flow line of the collector. All copper pipework should meet the requirements of I.S. EN1057:2006+A1:2010: *Copper and copper alloys – Seamless round copper tubes for water and gas in sanitary and heating applications* and be clearly marked in accordance with BS 1710:2014:*Identification of pipelines and services*. Ideally, pipes should take the shortest route to the solar store and always slope back to avoid air locks from the collector to the pump station.

All solar pipework should only be secured with metal pipe clips. Plastic clips can not withstand the higher temperatures generated by Solar Heating Systems and must never be used.

Flexible Pipe Connections

Flexible pipe connections are required to connect the manifold through the building fabric and allow flexibility in connecting to the internal pipe work. Flexible stainless steel pipes are available in both 15mm and 22mm diameter. If connecting one diameter pipe to another, a suitable reducer compression fitting is required to make the connection.

Types of Connections

The only pipes which should be used with a solar installation are copper pipe (to I.S. EN1057:2006+A1:2010), continuous flexible stainless steel or mild seamless steel pipe (to ISO 9329-1:1989: *Seamless steel tubes for pressure purposes – Technical delivery conditions – Part 1 Unalloyed steels with specified room temperature properties*. When using copper pipe, only compression fittings or brazed joints (at 900°C) can be used. Soft Solder joints are not suitable for solar installations.

Note: PEX/Plastic/PEX-ALU-PEX or galvanised tubing or fittings should NOT be used under any circumstances.

Pipe work Insulation

All pipe work on the solar loop shall be insulated with high temperature insulation suitable for use at temperatures above 150°C, such as HT/Armaflex or equivalent. This is essential as regular pipe insulation will degrade at temperatures experienced by solar pipes. The wall thickness of the insulation should be at least equal to the diameter of the pipe and must conform to the requirements of *Cl 1.4.4 of TGD Part L to the Irish Building Regulations*. The only pipes which should not be insulated are the pipes to the safety vessel, as they should allow heat to dissipate when the system is experiencing excessive heat and pressure.

2.4.8 Cylinder

Consideration should be given to the load bearing requirements of the Cylinder and the space required to house the solar cylinder, pump station and associated expansion vessel, valves and pipework, with regard to installation, inspection and maintenance.

The Certificate holder supplies the KIWA approved range of Excelstor solar Cylinders. The Excelstor solar cylinders are stainless steel twin or triple coil cylinders for use in pressurised or vented systems and have been developed specifically for solar applications. See Figure 9 and Table 3.

Figure 9: Excelstor solar Cylinders

See Table 4 for the full range of compatible Cylinders which can be used in conjunction with the Firebird Envirosol Solar Heating Systems. When installed on a pressurised system the cylinder and associated safety devices must be installed and commissioned by a qualified and certified plumbing heating engineer. Solid fuel heating systems must not be incorporated into a pressurised heating system.

In addition, other DHW cylinders may be used, provided they have NSAI Agrément Certification for use with this system.

A twin coil hot water storage cylinder enables energy input from the central heating system to the top half of the tank, and energy input from the solar heating system to the bottom half of the tank.

Cylinder storage size is calculated at twice the household's hot water demand, which is estimated at 50 litres/adult/day. The Certificate holder recommends a 200 litre cylinder for a one to two adult household, and a 300 litre cylinder for three to five adults.

All hot water storage vessels should carry a label containing the following information.
- Manufacturers name
- Nominal capacity in litres
- Standing heat loss in kWh/day
- Type of vessel
- Auxiliary heating heat exchanger performance in kW (where present)

A thermostatic mixing valve (TMV) set at 52ºC shall be installed with the Firebird Solar heating systems to prevent accidental scalding to the householder. In short pipe work runs without dead legs, where the legionella risk has been assessed to be minimal, the mixing valve can be located at the hot water outlet from the cylinder. Where a legionella risk has been assessed to be high, insulated recirculation pipe work should be installed and individual thermal mixing valves fitted to each of the hot water taps.

Insulation of the cylinder must comply with Clause 1.4.4 of TGD to Part L of the Building Regulations.

2.4.9 Solar Pump Station

The Firebird Envirosol solar system is managed by a twin-line solar pump station. The pump station incorporates a solar circulating pump with a 6m head, and flow isolation valves. The flow rate required on a system is typically 0.5 to 1 litre/minute per square metre installed.

Therefore, a 1-13 litre pump station will be sufficient for systems up to 12m^2 providing pipe work diameter, head and component losses have been calculated correctly.

Figure 10: Pump station

Table 3: Excelstor Cylinders					
Number of Adults	**Cylinder Size**	**CPK-7210N Flat Panel System**	**CVSKC-10 Vacuum Tube System**	**TZ58-1800 Heat Pipe System**	**Product Code**
1-2	200 Litre	2 Panel	20 Tubes (2 sets)	30 Pipes	SOL215TNK
3-5	300 Litre	3 Panel	30 Tubes (3 sets)	40-60 pipes	SOL305TNK
3-5	300 Litre	3 Panel	30 Tubes (3 sets)	40-60 pipes	SOL315TNK

Table 4: Cylinder Compatibility				
Manufacturer	**Cylinder Size**	**CPK-7210N Flat Panel System**	**CVSKC-10 Vacuum Tube System**	**TZ58-1800 Heat Pipe System**
Heatmerchants	210 Litre	2 Panel	20 Tubes (2 sets)	30 Pipes
	300 Litre	3 Panel	30 Tubes (3 sets)	40-60 Pipes
	500 Litre	5 Panel	50 Tubes (5 sets)	60-80 Pipes
Telford	200 Litre	2 Panel	20 Tubes (2 sets)	30 Pipes
	250 Litre	2-3 Panel	20-30 Tubes (2/3 sets)	30-40 Pipes
	300 Litre	3 Panel	30 Tubes (3 sets)	40-60 Pipes
	400 Litre	4 Panel	40 Tubes (4 sets)	50-70 Pipes
	500 Litre	5 Panel	50 Tubes (5 sets)	60-80 Pipes
Albian	180 Litre	2 Panel	20 Tubes (2 sets)	20-30 Pipes
	210 Litre	2 Panel	20 Tubes (2 sets)	30 Pipes
	250 Litre	3 Panel	30 Tubes (3 sets)	30-40 Pipes
	300 Litre	3 Panel	40 Tubes (4 sets)	40-60 Pipes

The 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 – 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 when solar fluid has been lost and how much was lost.

Connections of flow and return pipe work to the pump station are made with the straight compression fittings provided for direct copper connection.

The Firebird pump station must be fixed to a sound surface, suitable for holding the weight of the unit and should be in an accessible location and not obstructed or concealed to allow for easy inspection, maintenance and/or replacement.

Table 5: Solar Pump Station Product Codes		
Flow rates l/min	**Product Code**	**System**
1-13	SOL403CTR	Standard (Deltasol BS Plus Controller & FlowCon Pump Station)
1-13	SOL401CTR	East/West (Deltasol BS Plus Controller & FlowCon Pump Station)
1-13	SOL404FMT	Single Pump Station (add to existing FlowCon Pump Station)

2.4.10 Safety Vessel Connections

Pressure Relief Valve (PRV)

Rated at 6 bar, the Pressure Relief Valve (PRV) may discharge heat transfer fluid which must be channelled into a container capable of withstanding high temperature discharge and containing 1.5 times the total collector volume.

All safety control valves should be readily accessible and verifiable in operation, particularly during commissioning and maintenance.

The discharge container should be secured so it cannot be removed or spilled and have a drain facility. The PRV must not be channelled into a drain or any pipe work which will allow it to enter the normal water course.

Expansion Vessel

The intaEco solar expansion vessel supplied with the Firebird Envirosol Solar Heating Systems complies with DIN 4757 and is available in 24 and 35 Litre sizes betweens. See Table 6. The vessel is pre-charged to 2.5bar and has a maximum working pressure of 10bar. While the vessel membrane can tolerate temperatures of 100°C, it is recommended to fit the vessel on the return string of the pump station (cooler side).
The expansion vessel should be located (at least 500mm) below the level of the connection from the pump station to prolong its life. If this is not possible an intermediary Temperature Reducing Vessel should be installed between the pressure vessel and pump station.

Table 6: Expansion Vessel - Product codes			
Vessel (litre)	**Product Code**	**Charge Pressure (bar)**	**System Pressure (bar)**
24 litre	SOL502EXP	2	2.3
35 litre	SOL503EXP	2	2.3

The expansion vessel supplied with the Firebird Solar Collector Heating Systems includes an appropriate corrugated hose and threaded connection to join the vessel to the pump station.

The following should be noted during installation of the vessel:

- The vessel must only be installed in a vertical position.
- The vessel connection must face upwards.

- The charge pressure of the vessel should be checked and set at the required pressure for the size of the system.
- The fill pressure of the system should be approximately 0.3 bar greater than the charge pressure of the vessel.
- The vessel shall be fixed to a sound surface suitable for holding the weight of the unit.

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 into 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.

Figure 11: Expansion Vessel

Temperature Reducing Vessel

Long periods of high temperature fluid in the expansion vessel can have cause damage to its diaphragm. When the contents of the pipe work between the collector array and the expansion vessel (with a fixed membrane) is lower than 50% of the liquid capacity of a correctly dimensioned expansion tank, a intaEco Temperature Reducing Vessel is incorporated into the system as shown in Figure 12 and Table 7.

Table 7: Temperature Reducing Vessel - Product codes

Vessel (litre)	Product Code
5 litre	SOL505EXP
12 litre	SOL512EXP

Figure 12: Temperature Reducing Vessel

2.4.11 Solar Controller

The Firebird Solar Controller (Product Code SOL401CTR) 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 and 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.

Wiring the Solar Controller

All electrical aspects of the installation should be undertaken in accordance with ETCI regulations by a qualified electrician. For safety, the pump and sensor connections should always be wired prior to connecting power to the solar controller. The solar controller must have a permanent electrical power supply which must not be interrupted by a time switch. A switchable fused spur with LED should be used for the system. The solar heating system does not have to be drained if the power is disconnected. However, if the system is unused for extended periods it is recommended to drain the system to prevent degradation of the anti-freeze.

The Firebird solar controller is incorporated into the Firebird pump station but can also be independently located when required. The solar controller should be located in a prominent location that is readily accessible and frequently occupied, normally on the landing outside the solar store, fixed not less than 1.5m above floor level. The controller display should be readily visible at all times with clear access and not concealed or obstructed. In order to protect the normal operation of the controller, it should be located at least 100mm from insulated pipes which may become hot during operation.

Figure 13: Firebird control panel

To limit potential damage to the controller from lighting via the solar collector thermostat, a transient voltage suppression (TVS) diode (Product Code: SOL010TSV) can be incorporated into the system. See Figure 14.

In addition, all pipework shall be bonded in order to avoid electrical potential differences. The flow and return pipes to the solar collector should be fitted with earth clamps, connected to the earthling system of the property, using an earth bonding cable of 10mm^2 minimum.

Figure 14: Firebird TVS Diode

2.5 COMMISSIONING

Commissioning must be carried out by the trained and approved installer of the system. The system should not be commissioned if the collectors are in excess of 70°C because the pressures recorded will not be stable in the long term.

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, the collectors must be covered with a suitable weather and UV-proof cover.

Expansion Vessel

Prior to filling the system, the expansion vessel pressure must be set 0.3bar below the system pressure.

The pressure is checked at the base of the expansion vessel and the bleed valve may be bled or topped up with a pump. Omitting to perform this check will result in irregular pressure readings during the commissioning of the system.

Filling the solar system should only be carried out in low light with the collectors covered. Filling the system in high solar radiation conditions could cause damage to the solar collectors and other components.

Filling the Solar Circuit

Before proceeding to fill the solar circuit, an air pressure test must be performed to check for leaks.The filling system must be capable of delivering at least 5bar pressure.
See Cl. 3.5 of this Certificate for details of the three heat transfer fluids for use with the Firebird Envirosol Solar Heating Systems.

1. The pressure hose is connected from the filling station to the upper filling valve (see G1.a) and the flushing hose is connected to the flushing valve. Both valves are opened.
2. Using a slotted head screwdriver, the restrictor in the flow regulating valve is closed (see G1.b).
3. Both non-return valves must be opened see (G1.c) for filling, draining and flushing the system. By half opening the ball valves (ball valve has to be put in a 45° position) the non return valves will be opened.
4. The container of the filling station is filled with sufficient solar fluid for the system.
5. Using filling station, the solar circuit is filled and then flushed for approx. 15 minutes.
6. When the filling pump is running, the flushing valve is closed and the system pressure is set to around 4 bar. Pressurising the system to 4 bar will force solar fluid into the expansion vessel, this lines the walls of the expansion vessel and the membrane of the vessel that separates the pressurised air from the solar fluid. The solar fluid inhibitor properties will protect and prolong the life of the vessel.
7. When the pressure is reached, the filling valve is closed and the filling pump is immediately switched off. Check that the device is leak-free. If the manometer shows a significant drop in pressure, there may be a leakage in the system.
8. The flow regulating valve is re-opened and the circulating pump is switched on (control position "manual") to the highest pumping level (III) and allowed to circulate for at least 15 minutes.

9. The circulating pump should be bled by loosening the brass screw on the face.
10. The pump is switched off and the system is then bled, using the manual release valve on the de-aerator, until the heat transfer fluid begins to escape.
11. The operating pressure is set to 2.3 bar, by carefully opening the flushing valve and releasing the heat transfer fluid into the container of the filling station.
12. The hoses from the filling station are removed and the caps are screwed on to the filling and flushing valves (release the flushing valve first, then the filling valve).

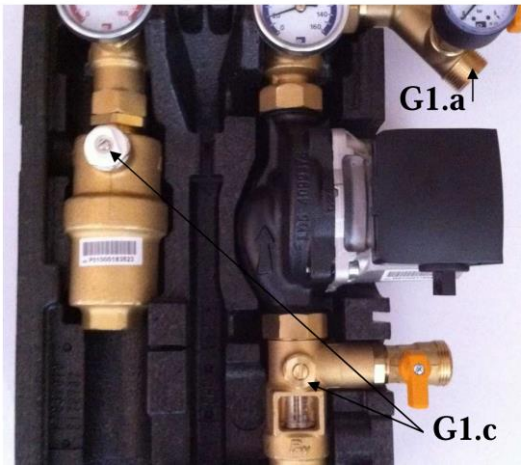


Figure 15: Filling Valves

Bleeding the Solar Circuit
The system must be bled:
- On commissioning (after filling) .
- Four weeks after commissioning.

Setting the 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 pump is set to the first speed and ran manually from the controller.
- If the desired flow rate is exceeded, the flow meter is set to the desired rate (to match the m² of aperture area of solar absorber) by adjusting the flow meter valve with the pump running.
- Otherwise this step is repeated at the next pump speed and continued until the desired flow rate is achieved.

Selecting the lowest pump speed possible to set the flow rate will use less energy and operate much quieter.

Once commissioning has been completed, the information is recorded on the Servicing & Maintenance Sheet.

Final Commissioning Requirements
- The installer must complete two copies of the Commissioning Certificate. One copy is left with the customer in the User Manual and the second copy is kept by the installer.
- The installer must complete the Maintenance Log, and locate it in a viewable position, e.g. attached to the expansion vessel or pump station.
- The installer must apply the Product ID label to the controller and the HOT PIPE warning labels (x2) to the cylinder flow and return.
- The installer shall hand over the User Manual to owners, and instruct users on all aspects of the documentation and how to effectively use the solar equipment.

User Manual
After commissioning, a user manual is given to the homeowner which contains important information about the system. The user manual includes a recommended maintenance schedule, commissioning certificate, full contact details of the installer and guidance on use.

Decommissioning the System
Due to temperatures potentially exceeding 170°C and pressures greater than 6 bar, a solar installation should only be decommissioned by a Firebird trained and approved installer . The system should be decommissioned in low light, ideally in the morning when the solar loop should be coolest, or by covering the collector array until it has cooled down to a safe working temperature.

2.6 MAINTENANCE

The Firebird Solar Collector Heating Systems should be maintained by competent persons with suitable training and practical experience of the systems.

Cl. 3.5 of this Certificate lists the Heat Transfer Fluids to be used with the Firebird Envirosol Solar Heating Systems, which provide frost protection to as low as -28°C. The level of frost protection in a solar system should be checked annually using a refractometer.

A pH test should be carried out on the solar fluid annually to check the level of acidity. If the level drops below 7 on the scale, the glycol should be changed. Frequent overheating of the solar fluid (stagnation) causes the glycol to disintegrate into acids, leading to corrosion of the solar collector, pipe work.

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

- Check of the solar circuit, tank and pump station for leaks.
- Check of solar system pressure. If pressure drop is detected, the system is topped up with glycol anti-freeze and re-pressurised.
- Inspection of external pipe insulation for damage, degradation or contamination
- Visual inspection of solar collectors for evidence of damage. Collectors should be cleaned as required using sponge with a mild soap and water solution.
- Inspection of mounting fixtures for evidence of damage and to ensure all connections are secure.
- Test of the glycol anti-freeze fluid - replace as necessary.
- Check on charge pressure of all expansion vessels and reset as necessary.
- Check of circuit flow rate (against commissioning card recorded setting) and adjust as necessary.
- Check of circulating pump for noise/damage.

2.7 RETROFITTING/REPLACING

The Firebird range of collectors can be retrofitted to existing roofs. During the pre-installation survey, special attention must be given to the condition of the existing roof structure and its ability to take the additional applied loadings of the collector as described in the Firebird Energy Solutions Risk Assessment and Site Survey assessment procedures.

The required slates/tiles are removed. The panels are fixed as described in Section 2.4 of this Certificate and the slates/tiles are then re-integrated as described.

Should the collectors require replacing, the flashings/tiles are removed as required, in reverse order to their installation, collectors replaced and the flashing reinstated.

1	Firebird Condensing Boiler
2	Unvented Cylinder 80L-100L
3	Temperature Stat
4	3 Way Mixing Valve
5	Solar Collector
6	Temperature Sensor
7	Pump Station
7A	Pressure Release Valve
7B	Solar Thermal Vessel
7C	Controller
8	DHW Tank Sensors

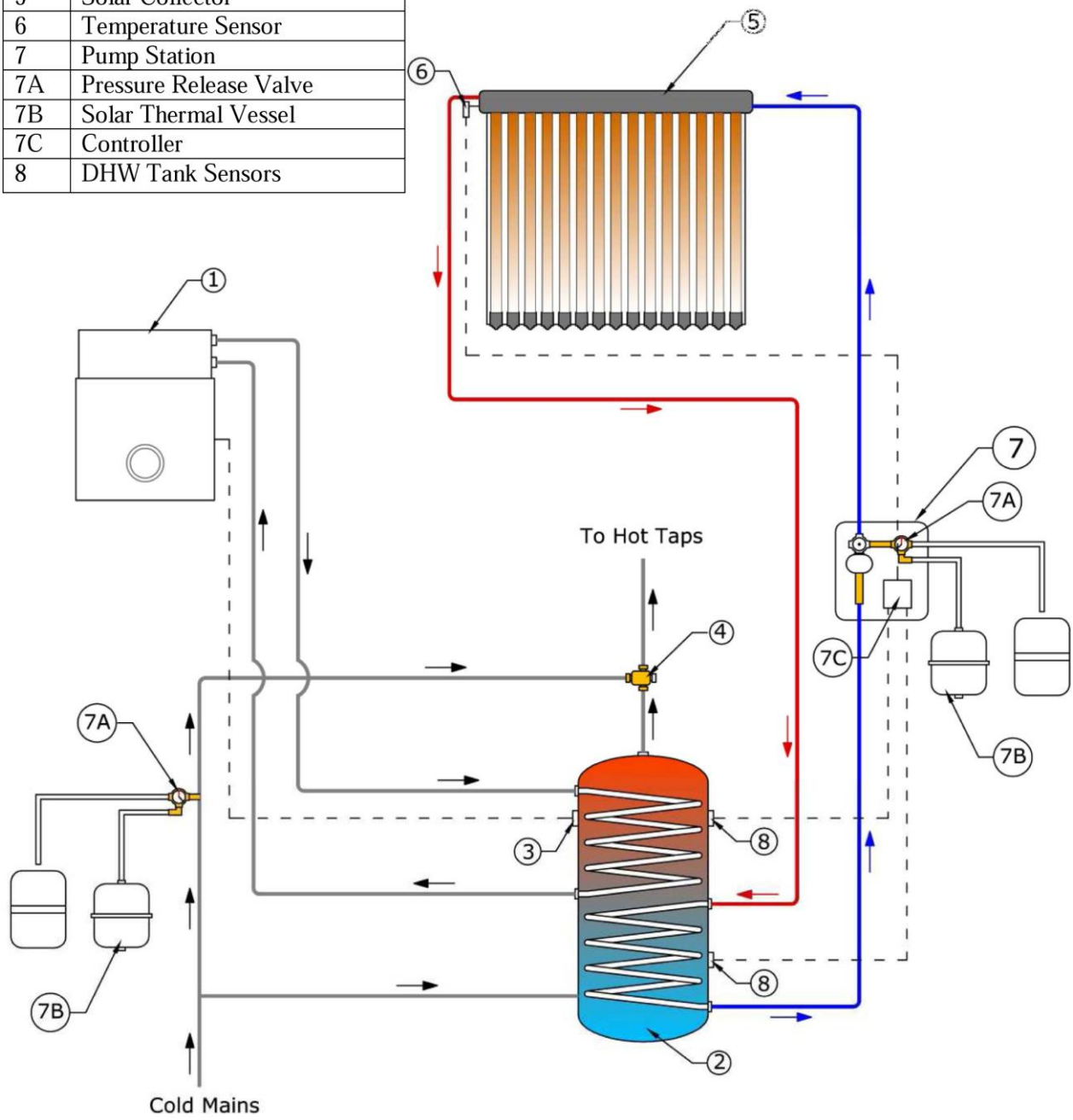


Figure 16: Unvented system

1	Firebird Condensing Boiler
2	Open Vented Cylinder
3	Temperature Stat
4	Cold Water Tank
5	Solar Collector
6	Temperature Sensor
7	Pump Station
7A	Pressure Release Valve
7B	Solar Thermal Vessel
7C	Controller
8	Isolating Valve
9	Solar Air Vent
10	DHW Tank Sensors

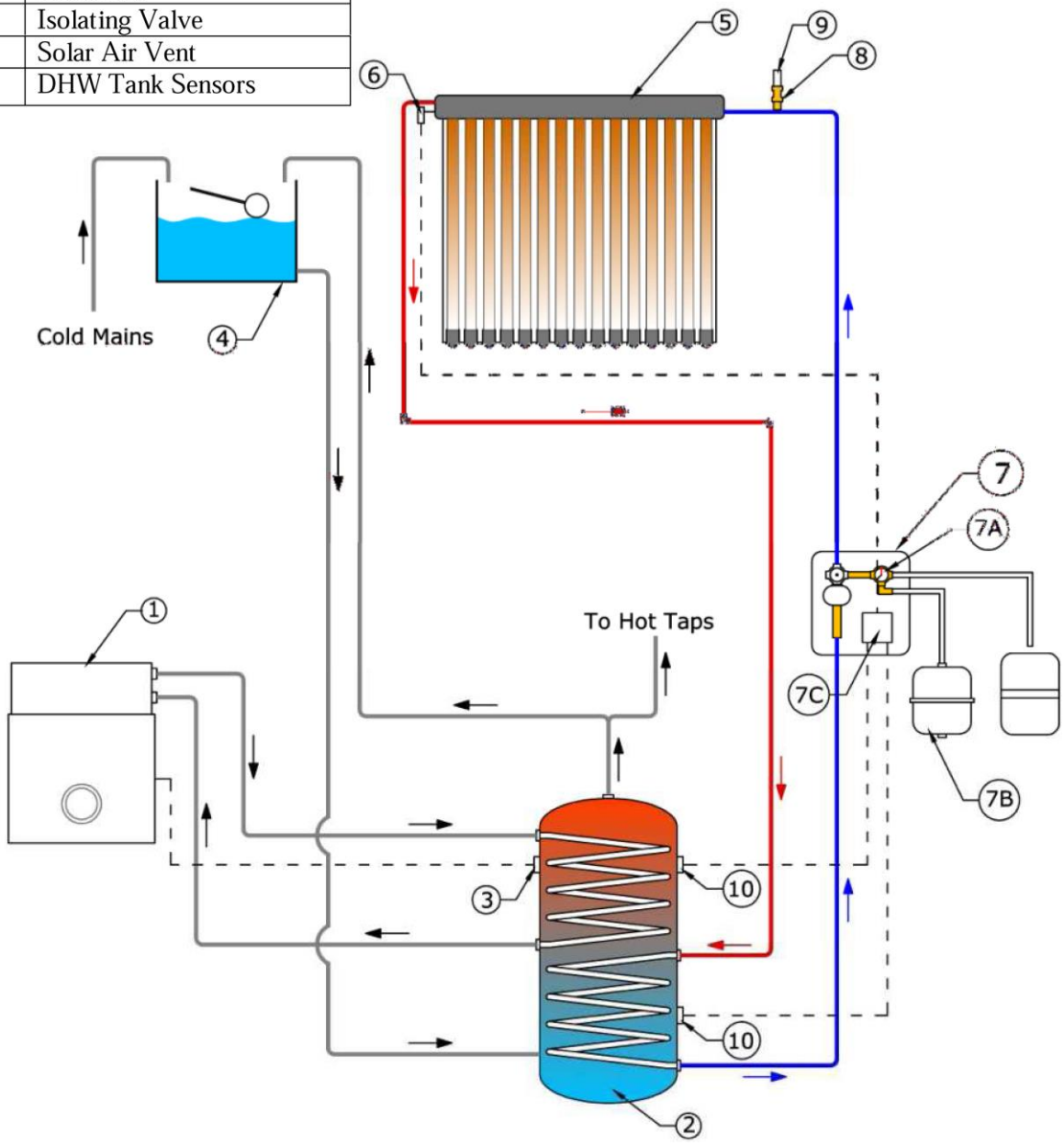


Figure 17: Open Vented System

1	Firebird Condensing Boiler
2	Open Vented Cylinder
3	Temperature Stat
4	Cold Water Tank
5	Solar Collector
6	Temperature Sensor
7	Pump Station
7A	Pressure Release Valve
7B	Solar Thermal Vessel
7C	Controller
8	Isolating Valve
9	Solar air Vent
10	DHW Tank Sensors

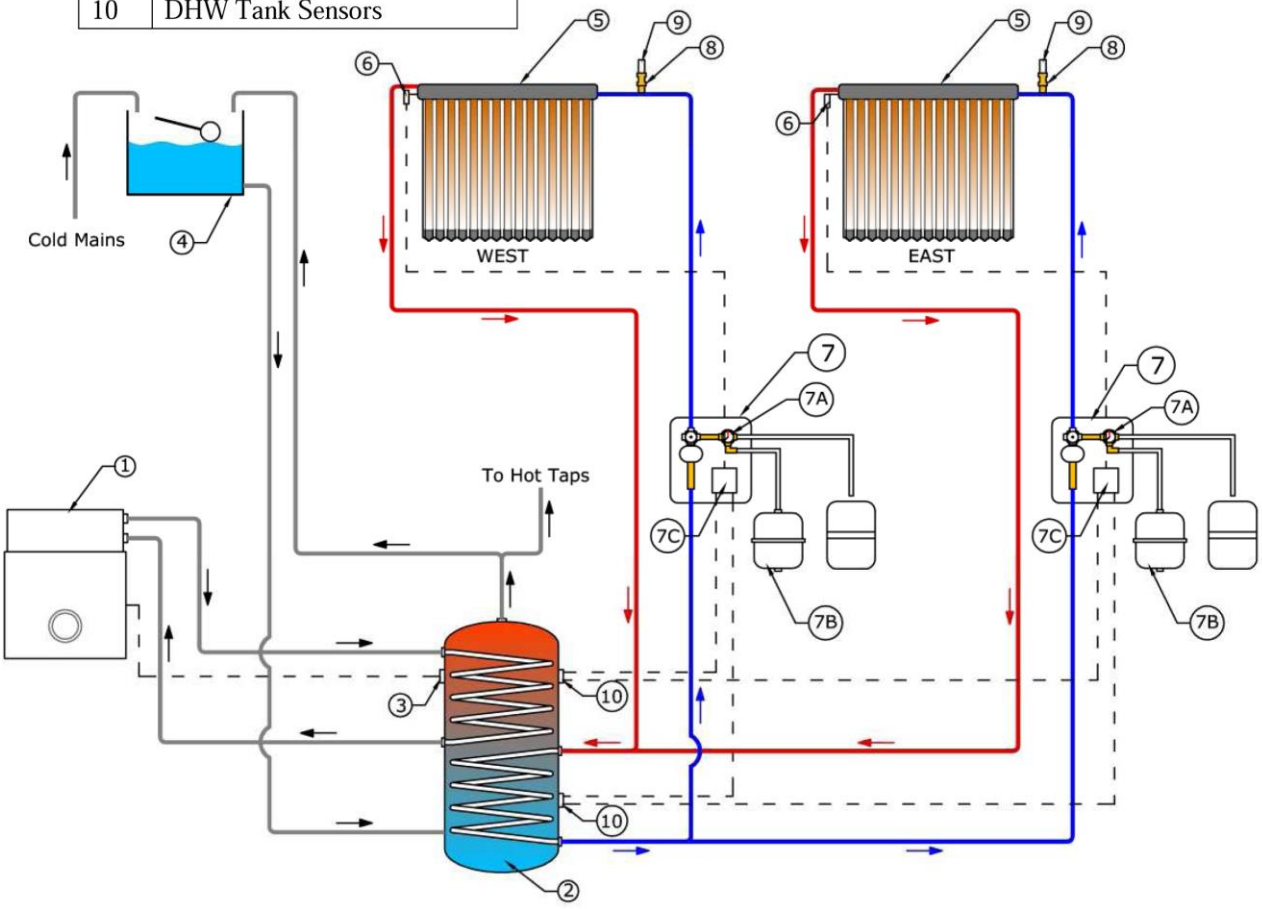


Figure 18: East / West Configuration

1	Firebird Condensing Boiler
2	DHW Tank (For Boiler)
3	Temperature Stat
4	DHW Tank (For Solar)
5	Solar Collector
6	Temperature Sensor
7	Pump Station
7A	Pressure Release Valve
7B	Solar Thermal Vessel
7C	Controller
8	Isolating Valve
9	Solar air Vent
10	DHW Tank Sensors

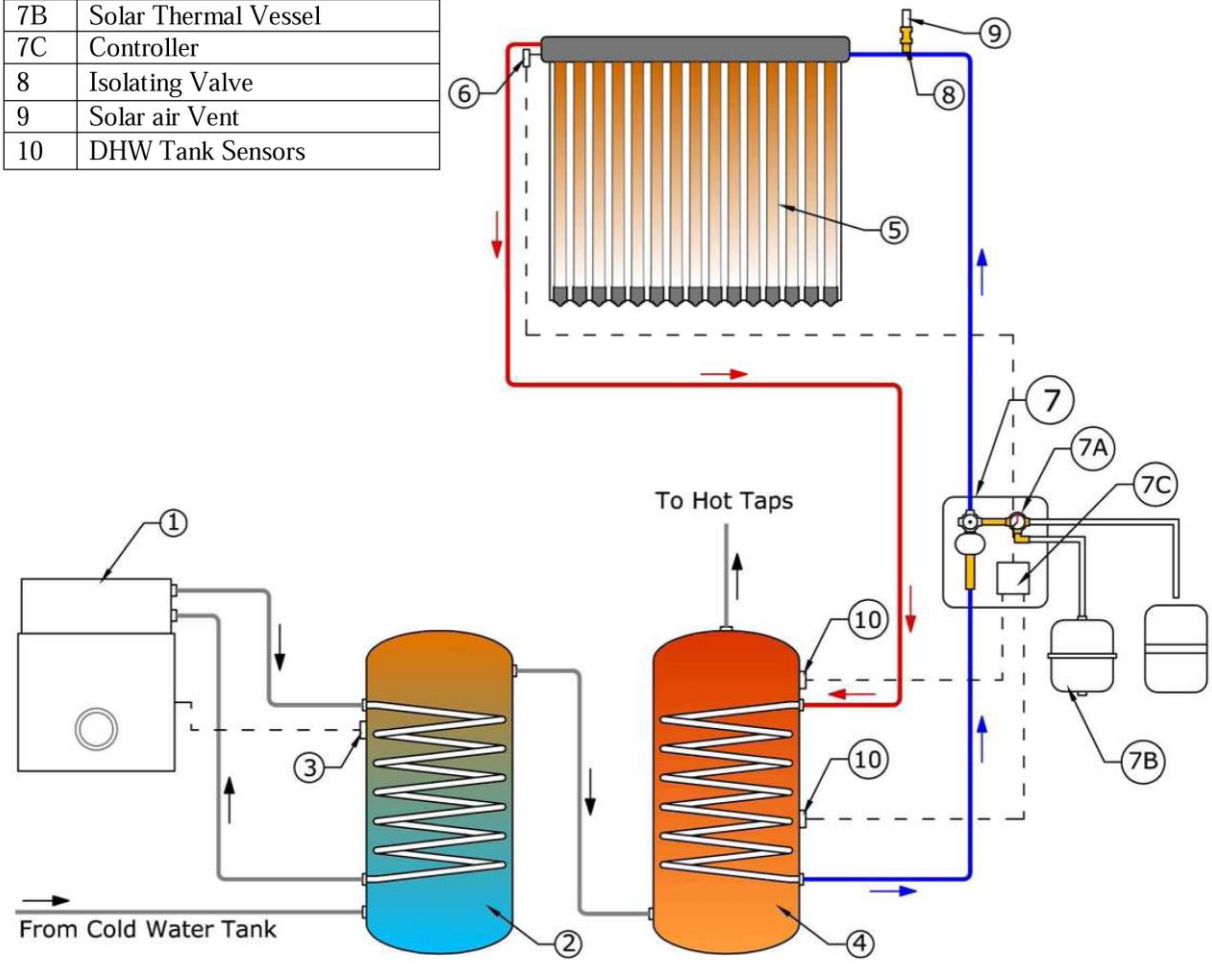


Figure 19: Two Tank System

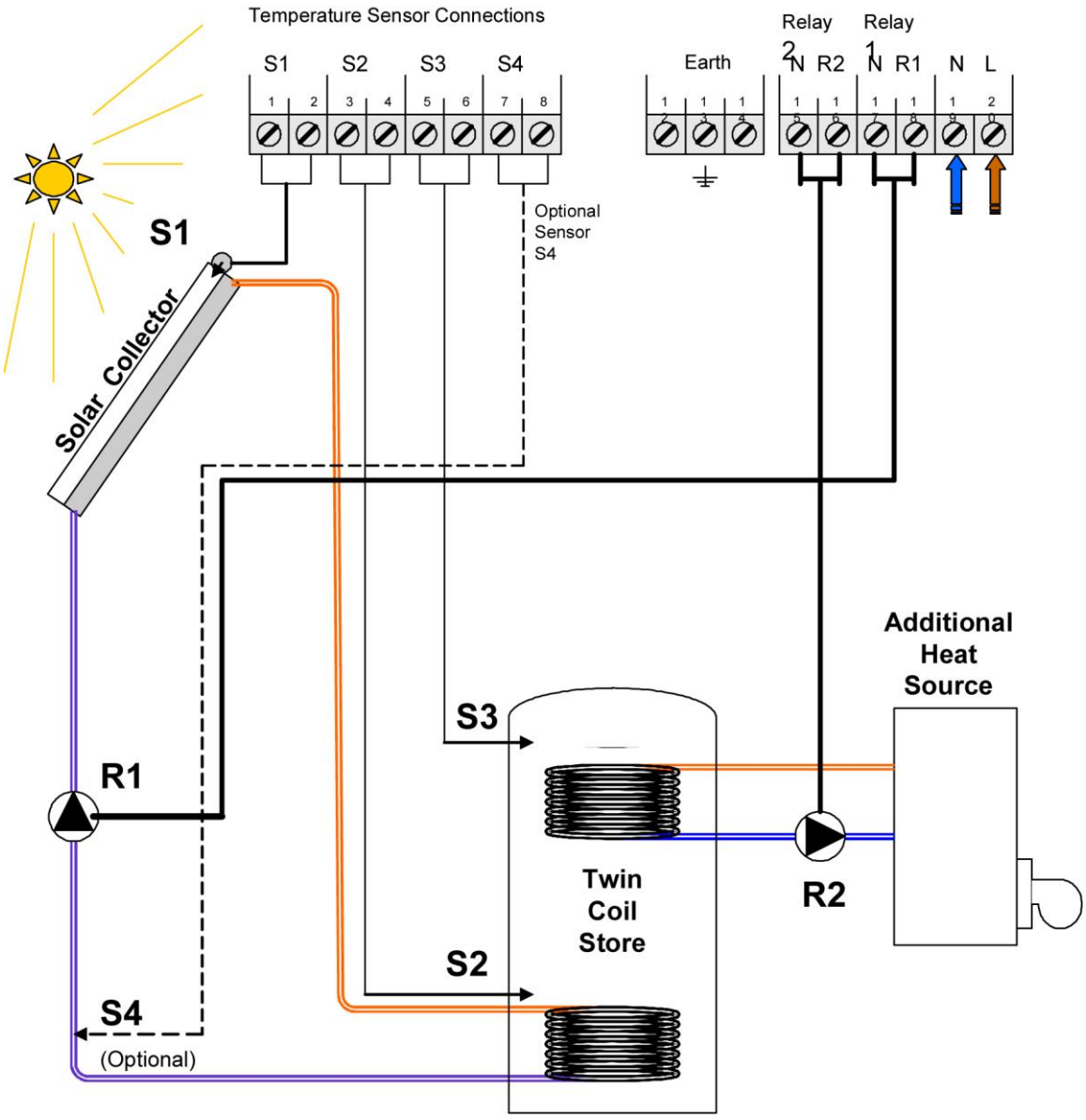


Figure 20: Controller Wiring Schematic (including Anti-Legionnaires function)

3.1 STRENGTH AND STABILITY

Firebird CPK7210N (Flat Panel)

When tested in accordance with EN 12975-2:2006 (I.S EN ISO 9806:2017), the Firebird CPK7210N Flat Plate Solar Collector was tested to 3000 Pa positive pressure (i.e. downward pressure) without failure occurring. Using the safety factor of 1.5 for positive pressure (Section 5.9.1 of EN 12975-2:2006), the Firebird CPK7210N Flat Plate Solar Collector can withstand a positive pressure of up to 2000 Pa. The Firebird CPK7210N Flat Plate Solar Collector was also tested to 1000 Pa negative pressure (i.e. upward pressure/uplift) without failure occurring. Using the safety factor of 2.0 for negative pressure (Section 5.9.2 of EN 12975-2:2006), the Firebird CPK7210N Flat Plate Solar Collector can withstand a negative pressure of 500 Pa. Further negative pressure testing was also performed by the manufacturer in accordance with EN 12975-2:2006, in excess of 3000Pa without evidence of failure. The equivalent factor of safety should also be applied to this loading.

In addition, wind uplift testing, (per MCS012: Microgeneration Certification Scheme, Roof performance tests for solar thermal collectors and PV modules: Draft 8, September 2010) based on I.S EN 14437:2005: *Determination of the uplift resistance of installed clay or concrete tiles for roofing – Roof System test method:* was performed on the CPK7210N Flat Plate and its associated mounting system. Results from the testing showed that the Firebird Flat Plate Collector achieved a characteristic uplift (Negative) resistance of 2136 Pa. The equivalent factor of safety should also be applied to this loading.

Firebird CV-SKC10 (Vacuum Tube)

When tested in accordance with EN 12975-2:2006 (I.S EN ISO 9806:2017), the Firebird CV-SKC10 Vacuum Tube Solar Collector was tested to 2300 Pa negative pressure (i.e. upward pressure/uplift) without failure occurring. Using the safety factor of 2.0 for negative pressure (Section 5.9.2 of EN 12975-2:2006), the Firebird CV-SKC10 Vacuum Tube Solar Collector can withstand a negative pressure of 1150 Pa.

The Firebird CV-SKC10 collector was found to withstand a positive pressure of 1980 Pa. when testing was also performed by the manufacturer in accordance with EN 12975-2:2006. The equivalent factor of safety should also be applied to this loading.

In addition, wind uplift testing (per MCS012), based on I.S EN 14437:2005 as performed on the Firebird CV-SKC10 (Vacuum Tube) and its associated mounting system. Results from the testing showed that the Firebird Vacuum Tube Collector achieved a characteristic uplift (Negative) resistance of 2824Pa (min), 5370 (max) - based on the minimum and maximum projected area of the reflector plates. The equivalent factor of safety should also be applied to this loading.

Firebird TZ58-1800 (Heat Pipe)

The Firebird TZ58-1800 Heat Pipe collector was tested to 1000 Pa positive pressure (i.e. downward pressure) without failure occurring. Using the safety factor of 1.5 for positive pressure, the Firebird TZ58-1800 collectors can be deemed to withstand a positive pressure of up to 666 Pa.

The negative pressure (uplift) test was not conducted as any negative pressure on the fixing between the vacuum tubes and the casing are deemed to be negligible.

In addition, wind uplift testing (per MCS012), based on I.S EN 14437:2005 was performed on the Firebird TZ58-1800 (Heat Pipe) and it's associated mounting system. Results from the testing showed that the Heat Pipe Collector achieved a characteristic uplift (Negative) resistance of 3584Pa. The equivalent factor of safety should also be applied to this loading.

General

Additional testing was performed on the Firebird stainless steel (SS) S-bracket utilising the central screw fixing method.

The collectors and fixing bracket systems are designed to cover all Irish wind zones (as illustrated in Figure NA.1 in Irish National Annex to Eurocode 1). However In high wind load areas, e.g. at excessive heights or very exposed areas, wind loads should be calculated in accordance with I.S. EN 1991-1-4 *Eurocode 1 – Actions on structures – General actions – Wind actions* as additional roof fixing brackets may be required.

The advice of the Certificate holder should be sought when the force acting upon the solar collector is greater than the above tested values. To minimise the effect of wind load on the collectors, it is recommended that collectors are not installed within 0.5m of the roof edge, ridge, eaves or projections such as parapets, chimneys or dormer windows.

The host roof structure, and any modifications necessary to accommodate the Firebird Solar Heating Systems, should be checked by a suitably qualified engineer in accordance with the Building Regulations. The installer of the system must ensure that this has been done prior to commencing installation.

3.2 IMPACT RESISTANCE

Firebird CPK7210N (Flat Panel)

When tested for impact resistance in accordance with EN 12975-2:2006 Cl.5.1 - Method 1 (I.S EN ISO 9806:2017), the Firebird CPK7210N (Flat Panel) collector met the pass criteria for 150g steel ball impact up to 2m height.

Firebird CV-SKC10 (Vacuum Tube)

When tested for impact resistance in accordance with EN 12975-2:2006 Cl.5.1 (Method 1) the Firebird CV-SKC10 (vacuum Tube) collector sustained no damage when impact tested using a 150g steel ball up to a height of 0.4 m.

Firebird TZ58-1800 (Heat Pipe)

When tested for impact resistance in accordance with EN 12975-2:2006 Cl.5.1 (Method 2) the Firebird TZ58-1800 (Heat Pipe) collector met the pass criteria for 25mm hail (Mass of 7.53g and Impact Velocity of 23m/s).

3.3 COLLECTOR EFFICIENCIES

The ability to convert solar energy into thermal energy is expressed by the optical efficiency, η_0, (zero-loss collector efficiency in SEAI DEAP software) of the system. Table 1 shows the η_0 values for the Firebird Solar Collectors when tested to EN 12975-2:2006 (I.S EN ISO 9806:2017).

At high levels of sunlight (1000W/m^2), when the average system fluid temperature is slightly higher than ambient temperature (10K), system utilising the Firebird collectors can transfer approximately 1.3 kW of energy for the Firebird CPK7210N (Flat Panel) Collector,0.95 kW of energy for the CV-SKC10 (Vacuum Tube) Collector and 2 kW of energy for the TZ58-1800 (Heat Pipe) collector (based on the TZ58-1800-30R - 30 tube set) to the building hot water store. Test results of the performance of the collectors are shown in Table 1 and 2.

3.4 RISK OF BACTERIAL GROWTH / LEGIONELLA

The installer of the Firebird Envirosol Solar Heating System completes a Legionnaires Checklist as part of the initial risk assessment of the site during the pre-installation survey. If a risk of legionella is identified during this risk assessment then the anti legionella/thermal disinfection function (ODT) of the Firebird Deltasol solar control panel (Product Code: SOL401CRT) is activated. See Figures 13 and 20. Guidance shall be sought from the Certificate Holder in all such instances. When this function is activated the full contents of the cylinder is heated to 60ºC (measured at the base of the cylinder) utilising the immersion heater or boiler, at a frequency set by the timer (daily for cylinders with a capacity of over 400 litres). Scald out time, set by the installer, is dependent on the cylinder temperature and volume.

In addition, a thorough review of all pipework is required in such situations with alterations incorporated as required to limit risk.

Information and guidance is provided to the homeowner by the installer on the correct operation of the solar heating system during normal operation and after periods of non-use, to help reduce the risk of legionella.

Examples of areas where a risk of legionella may be identified include long periods of non-use of the hot water supply, infrequently used outlets such as showers and taps, and residents who are highly vulnerable to infection. For further guidance, refer to the HPSC (Health Protection Surveillance Centre) document *National Guidelines for the Control of Legionella in Ireland* and the NDSC (National Disease Surveillance Centre) document *The Management of Legionnaires' Disease in Ireland*.

3.5 HIGH TEMPERATURE CONDITIONS

The Certificate holder supplied the following three heat transfer fluids for use with the Firebird Envirosol Solar Heating Systems.

Tyfocor L: For use with the CPK7210N (Flat Panel) Collector. Tyfocor L is a 1,2-propylene glycol based heat transfer fluid. It is supplied diluted with 60% water to provide -24ºC freeze protection and a target pH value of 7.5 -8.5.

Tyfocor LS: For use with the CV-SKC10 (Vacuum Tube) or TZ58-1800 (Heat Pipe Collectors. Tyfocor LS is a 1,2-propylene glycol based heat transfer fluid. It is supplied in its usable form and **must never** be diluted with water to provide. It provides -28ºC freeze protection and a target pH value of 9.0-10.5.

Zitrec LC : For use with all three Firebird collector types. Zitrec LC is a mono propylene glycol based heat transfer fluid. It is supplied diluted with 60% water to provide -28ºC freeze protection and a target pH value of 7.5 – 9.0.

Reference should be made to the Safety Data Sheets for the above heat transfer fluids for safety precautions that apply.

Continuous temperatures in excess of 170°C will cause the degrading of the antifreeze solution and its inhibitor properties and will also cause damage to the collectors, pump station (rated at 160 °C max.) and expansion vessel (rated at 100° C max.) in the system. A thermostatic mixing valve should be installed with the systems to prevent accidental scalding due to high temperatures.

The Firebird Envirosol control panel uses the following functions to prevent collector and cylinder overheating from occurring.

Thermostat Function
This function allows the controller to control the circulator supplying to the hot water system depending on a pre-defined temperature difference.
When the temperature in the cylinder exceeds the defined 'on' value (typically 75°C), the pump is switched on until the temperature difference falls below the 'off' value (typically 60°C). This cycle will continue until the collector temperature has been reduced.

Stagnation Reduction Function
This function delays the end of the cylinder's loading phase in order to reduce, or even to avoid, the system's stagnation times at high temperatures. This function causes the pump to be stopped repeatedly, and only briefly switched on again when high collector temperatures arise. With higher collector temperatures, the efficiency decreases significantly, thus loading takes longer. This delays the beginning of any stagnation time.

Holiday Function/Re-cooling
This function is typically enabled when the household is on holiday. This function has to be activated on long/medium term departure and will allow the maximum temperature of the hot water cylinder to be increased to 80°C during the day. In the evening , the circulating pump continues to circulate the water through the coil in the cylinder and back up to the solar collector until such time as the temperature in the cylinder cools down to the default cylinder maximum temperature which is 60°C. Note: This function should not be activated unless a thermostatic mixing valve is installed on the hot water supply to avoid the risk of scalding.

Heat Dump System
The Certificate holder also offers the option to install a heat dump radiator with and independent circulating pump connected to the upper coil of the cylinder to dissipate excess heat from the cylinder. This circulating pump is connected to R2 of the Solar Controller (Reference should be made the Firebird Envirosol Controller Manual for AHO and AHF Settings when using this function). See Figure 20.

See also Cl.2.4.10 of this Certificate for details of the temperature reducing vessel that can be use with the Firebird Envirosol Solar Heating Systems. This can be fitted between the Pump station and the pressure vessel to cool down very high temperature solar fluid before reaching and causing damage to the diaphragm in the expansion vessel.

3.6 LIGHTNING PROTECTION

To limit potential damage from lightning, a transient voltage suppression (TVS) diode should be incorporated in series with the collector sensor.

All pipe work is bonded to avoid electrical potential differences and the collector should be earthed as detailed in paragraph 2.4.10 of this Certificate.

In general, the risk of property damage due to lightning is relatively low in Ireland for domestic properties, and installation of the Firebird Envirosol Solar Heating System does not generally increase the level of risk as the collectors are placed below ridge level and not higher than the chimney. Where a building requires specific lightning protection, the collector should be connected to the lightning protection system.

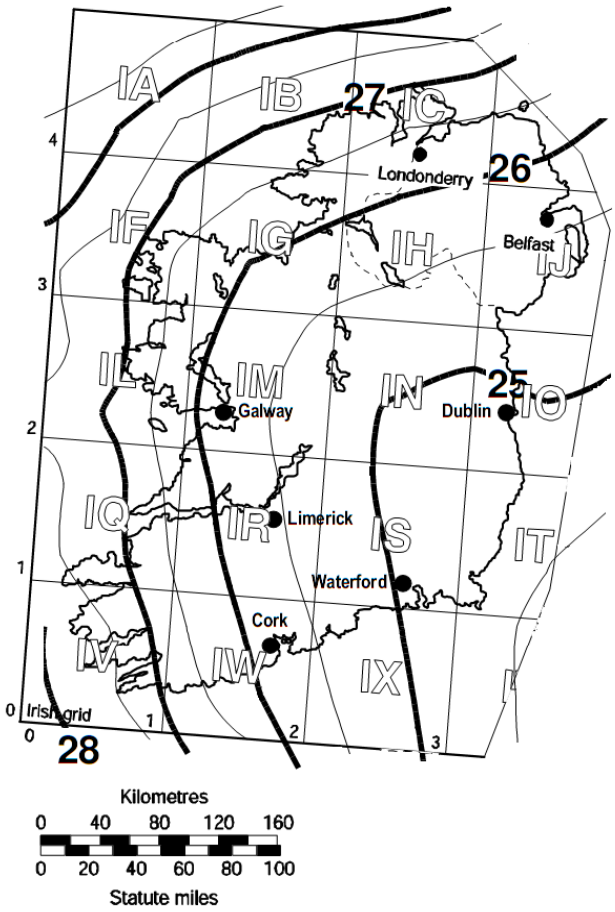


Figure 21: Basic Wind Velocity (ref. Irish National Annex to Eurocode 1)

4.1 BEHAVIOUR IN RELATION TO FIRE

The roof covering on which the collectors are installed must have an AA, AB or AC rating as stated in Table 4.4 of TGD to Part B of the Building Regulations.

When tested in accordance with BS 476-3:2004 *Fire tests on building materials and structures – Classification and method of test for external fire exposure to roofs*, the Firebird CPK7210N In-roof Flat Panel solar collector assembly achieved an EXT.S.AB rating when incorporated into a slate roof. When tested and in accordance with ENV 1187:2005 *Test methods for external fire exposure to roofs (*SR CEN/TS 1187:2012), and classified in accordance with the requirements of I.S. EN 13501-5:2016 *Fire classification of construction products and building elements - Classification using data from external fire exposure to roofs tests,* the Firebird Envirosol In-roof solar collector assembly achieved a B_{Roof}(T4) rating.

Reference should be made to the Safety Data Sheets for the heat transfer fluids listed in Cl. 3.5 of this Certificate for safety precautions that apply in case of fire.

Where pipes pass through fire-rated walls or cavity barriers, they must be adequately fire stopped, without compromising provision for thermal expansion.

Combustible materials should not be exposed to solar heating equipment having operating temperatures which can cause ignition.

4.2 WEATHERTIGHTNESS

Weathertightness testing was performed on each of the Firebird Envirosol Solar collectors.

For the On-roof collectors, the two fixing methods (Coach Bolt fixings and S-type brackets) detailed in Cl.2.4.4 of this certificate were tested (per MCS012: Microgeneration Certification Scheme, Roof performance tests for solar thermal collectors and PV modules: Draft 8, September 2010) on a tiled rood against the principles of prEN 15601: *Hygrothermal performance of buildings- Resistance to wind-driven rain of roof coverings with discontinuously laid small elements- Test methods.* Both fixing methods met the pass criteria for this test.

The Firebird CPK7210N (Flat Panel) In-roof assembly (including top, side, bottom and joining flashings) also met the pass criteria when tested against the principles of prEN 15601 on a slate roof.

In addition, the Firebird underlay sealing method, utilising the self adhesive collar, detailed in Cl. 2.4.6 also met the pass criteria when tested against the principles of prEN 15601.

Completed roofs will provide adequate resistance to weather ingress, when installed in accordance with this Certificate and the Certificate holder's installation instructions. Particular attention must be paid to correct installation of all components and to the detailing and positioning of gaskets and areas where pipe work enters the building.

4.3 MAINTENANCE

Users should regularly check the temperatures which the solar control panel is recording. If the collector temperatures have been excessively high, i.e. over 170°C, it is recommended that the transfer fluid antifreeze level be checked using a refractometer by an approved installer/qualified engineer.

If the transfer fluid has lost its antifreeze properties, the system should be refilled with the appropriate heat transfer fluid that was originally installed with the system (as identified on the Commissioning Report). See Cl. 3.5 of this Certificate for the range transfer fluid provided by the Certificate holder. With correct operation of the Firebird Envirosol Solar Heating Systems, the firebird range of transfer fluids should remain operative for up to 8 years, when replacement is required.

It is recommended that the solar heating system is serviced annually by a qualified engineer and immediately if the system shows evidence of having lost pressure or has discharged liquid at the pressure relief valve. Items checked on the annual service include the system pressure (including expansion vessel pressure), flow rate, transfer fluid level, pH reading, inspection of the collectors and flashings (including the Glidevale G1 vent tile), inspection of system pipe work (including insulation) and the hot water storage cylinder. A full guide on the maintenance requirements is included in the Firebird Envirosol Thermal Installation and User Instructions Manual. See also paragraph 2.6 of this Certificate.

4.4 DURABILITY

In the opinion of NSAI Agrément, when installed in accordance with this Certificate and the manufacturer's instructions, the Firebird Envirosol Solar Heating Systems will have a design life as solar collectors in the order of 20 years with regular inspection and maintenance.

The structural durability of the Firebird Envirosol collectors fixings, flashing etc. has been assessed, and if maintained as per the Firebird Envirosol Installation and User Instructions Manual, should have a design life equivalent to that of the roof structure on/in which they are incorporated.

4.5 TESTS AND ASSESSMENTS WERE CARRIED OUT TO DETERMINE THE FOLLOWING

- Internal pressure of absorber
- High temperature resistance
- Exposure
- Determination of stagnation temperature
- External and internal thermal shock
- Rain penetration and Weathertightness
- Mechanical load and wind up-lift testing
- Impact resistance
- Thermal Performance
- Spread of Flame/Fire Penetration

4.6 OTHER INVESTIGATIONS

(i) Existing data on product properties in relation to fire, toxicity, environmental impact and the effect on mechanical strength/stability and durability were assessed.

(ii) The manufacturing process was examined including the methods adopted for quality control, and details were obtained of the quality and composition of the materials used.

(iii) Site visits were conducted to assess the practicability of installation and the history of performance in use of the product.

5.1 National Standards Authority of Ireland ("NSAI") following consultation with NSAI Agrément has assessed the performance and method of installation of the product/process and the quality of the materials used in its manufacture and certifies the product/process to be fit for the use for which it is certified provided that it is manufactured, installed, used and maintained in accordance with the descriptions and specifications set out in this Certificate and in accordance with the manufacturer's instructions and usual trade practice. This Certificate shall remain valid for five years from date of issue so long as:

(a) the specification of the product is unchanged.

(b) the Building Regulations and any other regulation or standard applicable to the product/process, its use or installation remains unchanged.

(c) the product continues to be assessed for the quality of its manufacture and marking by NSAI.

(d) no new information becomes available which in the opinion of the NSAI, would preclude the granting of the Certificate.

(e) the product or process continues to be manufactured, installed, used and maintained in accordance with the description, specifications and safety recommendations set out in this certificate.

(f) the registration and/or surveillance fees due to NSAI Agrément are paid.

5.2 The NSAI Agrément mark and certification number may only be used on or in relation to product/processes in respect of which a valid Certificate exists. If the Certificate becomes invalid the Certificate holder must not use the NSAI Agrément mark and certification number and must remove them from the products already marked.

5.3 In granting Certification, the NSAI makes no representation as to;

(a) the absence or presence of patent rights subsisting in the product/process; or

(b) the legal right of the Certificate holder to market, install or maintain the product/process; or

(c) whether individual products have been manufactured or installed by the Certificate holder in accordance with the descriptions and specifications set out in this Certificate.

5.4 This Certificate does not comprise installation instructions and does not replace the manufacturer's directions or any professional or trade advice relating to use and installation which may be appropriate.

5.5 Any recommendations contained in this Certificate relating to the safe use of the certified product/process are preconditions to the validity of the Certificate. However the NSAI does not certify that the manufacture or installation of the certified product or process in accordance with the descriptions and specifications set out in this Certificate will satisfy the requirements of the Safety, Health and Welfare at Work Act 2005, or of any other current or future common law duty of care owed by the manufacturer or by the Certificate holder.

5.6 The NSAI is not responsible to any person or body for loss or damage including personal injury arising as a direct or indirect result of the use of this product or process.

5.7 Where reference is made in this Certificate to any Act of the Oireachtas, Regulation made thereunder, Statutory Instrument, Code of Practice, National Standards, manufacturer's instructions, or similar publication, it shall be construed as reference to such publication in the form in which it is in force at the date of this Certification.

NSAI Agrément

This Certificate No. **11/0363** is accordingly granted by the NSAI to **Firebird Boilers** on behalf of NSAI Agrément.

Date of Issue: **June 2011**

Signed

Seán Balfe
Director of NSAI Agrément

Readers may check that the status of this Certificate has not changed by contacting NSAI Agrément , NSAI, 1 Swift Square, Northwood, Santry, Dublin 9, Ireland. Telephone: (01) 807 3800. Fax: (01) 807 3842. www.nsai.ie

Revisions

- **16 January 2018:** References to Building Regulations, standards and related content updated.
- **23 June 2023:** References to Building Regulations updated