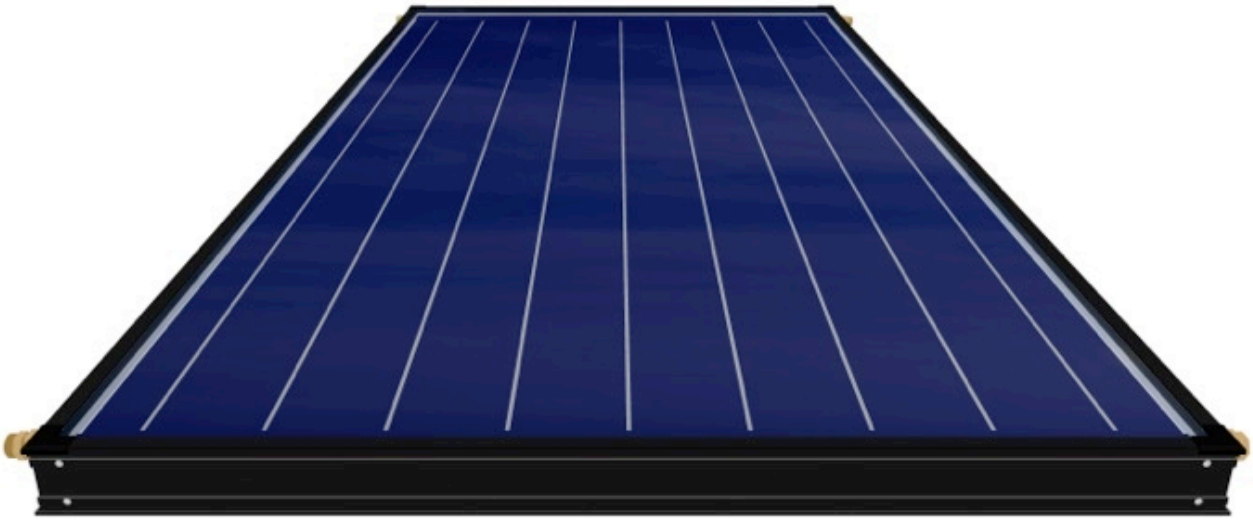


Apricus FPC-A Flat Plate Solar Thermal Collector

Installation and Operation Manual

International Edition

(Version 4 - Dec 2013)

Contents

⚠ WARNING
Indicates important information that must be followed to avoid potentially hazardous situations that could result in death, serious injury, or substantial property damage.

1. Important Information

1.1. Scope of Manual

a) This manual pertains only to the installation and operation of the Apricus FPC-A range of flat plate collectors. Details for the installation, operation and maintenance of the complete solar system components should be provided separately by their respective manufacturers.

b) This manual is primarily a reference document for installation officers, as the solar collector is not permitted to be installed by non-authorised persons.

1.2. Local Standards

Installation must be completed in accordance with all relevant local standards and regulations.

1.3. Authorized Person(s)

a) The term “authorised person(s)” used throughout this document refers to a suitably qualified professional, who holds relevant industry licenses or certificates required for the work completed during the installation process.

b) Installation may only be completed by authorised persons.

c) Unless otherwise specified in section 3, no part of any Apricus FPC-A solar collectors may be inspected, repaired or maintained by anybody other than an authorised person(s).

1.4. Collector Dimensions & Weights

Specification	Model: FPC-A26	Model: FPC-A32
Length	1981mm / 78”	2444mm / 96”
Width	1223mm / 48”	1223mm / 48”
Height	80mm / 3.15”	80mm / 3.15”
Peak Output*	1706 W / 5820 Btuh	2114 W / 7213 Btuh
Aperture Area	2.26m^2 / 24.3ft^2	2.8m^2 / 30.14ft^2
Gross Area	2.42m^2 / 26ft^2	2.99m^2 / 32.2ft^2
Gross Dry Weight	40kg / 88 lbs	46kg / 101.4 lbs
Fluid Capacity	1.55L / 52.4 floz	1.8L / 61 floz
Absorber Sheet	0.4mm Aluminium Tinox Energy	
Insulation	Melamine Foam	
Glass Cover	3.2mm Hardened Glass	
Seals	HTV Silicone Rubber HTV	
Back Sheet	0.8mm 5052-H16 Aluminium	
Collector Body	6063 Black Anodized Aluminium	

* TUV test report; G=1000W/m^2 / 317.1 Btu/ft^2

2. Unpacking and Inspection

2.1. Component List

a) Review the components list included in the collector manifold packing box. If any components are missing, or additional parts are required, contact the local supplier.

2.2. Inspection

a) Check the glass cover to ensure it is not broken and the corners of the panel for any sign of damage that may have occurred during transport.

2.3. Frame

a) Unpack the frame components that are packed separately (not supplied with the collector). See section 4 for frame diagrams.

b) Depending on the roof surface, rubber pads, roof attachment straps, round feet, roof rails or U feet may be used to attach the standard frame to the roof. These components are supplied separately from the standard frame.

⚠ WARNING
THE CORNERS OF THE ALUMINIUM CASING CAN BE SHARP, SO HANDLE CAREFULLY AND WEAR PROTECTIVE GLOVES.

3. System Design

3.1. System Design

System design should be completed prior to commencing installation. Solar collectors need to be installed correctly to ensure high efficiency, and most importantly, safe and reliable operation. Please seek professional advice for the design and installation of seek solar heating system. Only authorised installers are permitted to install the solar collector. Apricus does not provide warranty coverage and will not be held liable for any damage to person or property that results from solar collectors that are installed by unauthorised persons.

3.2. Avoid Shade

a) Collectors should be located so that shading does not occur for at least the 3 hours either side of 12 noon local time.

b) Partial shading due to small objects such antennas and small flues, is not of great concern.

3.3. Installation Angle

a) For optimal annual solar output, install the collector at an angle equal to the location's latitude. An angle of +/- 10^{o} is acceptable, and will not greatly effect output.

b) If the system is likely to exceed demand in the summer, install the collector at an angle 15-20^{o} greater than the latitude of the location which will help reduce summer output and maximise winter output.
E.g. Latitude of 30^{o}, install at 45-50^{o}.

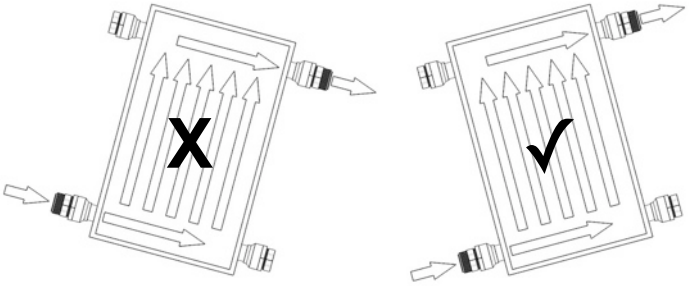
c) The collector may be installed from 0^{o} (flat) to 90^{o} (vertical) angle.

d) The collector may be installed in a portrait or landscape orientation. See also section 3.4 about vent plugs.

3.4. Collector Horizontal Slope

a) If installing on an horizontal angle ensure the outlet it at the highest point to allow air to purge.

b) If used in a drain-back system, the collector may be sloped to achieved desired drainage of the heat transfer fluid. A minimum slope of 1.4" per foot or 1.2^{o} is recommended.



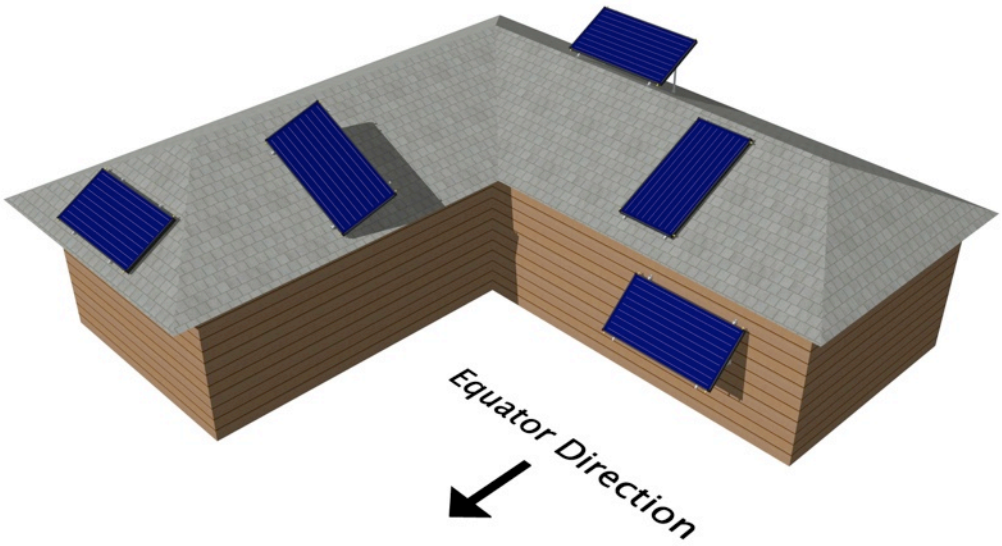
3.5. Collector and Tank Location

a) The collector should be positioned as close as possible to the storage tank to avoid long pipe runs.

b) The storage tank should be located as close as possible to the most frequent hot water draw off points in the building.

3.6. Collector Direction

a) The collector should face the equator, which if in the northern hemisphere is due South, and southern hemisphere is due North. A deviation of up to 15^{o} from due North or South is acceptable, and will have minimal effect on heat output. The collector will still work even facing East or West, but will loose most of the afternoon sun or morning sun respectively. The diagram below shows a variety of suitable installation positions for good solar exposure.



3.7. Heat Transfer Fluids

a) In regions where freeze protection is not a concern, water is the most appropriate heat transfer fluid. Water must be potable rated (suitable for drinking) if the system is direct flow.

b) In all cases the water or other type of heat transfer fluid must meet the following quality requirements:

Total dissolved solids	*< 600 p.p.m.*	*Total hardness*	*< 200 p.p.m.*
Chloride	*< 250 p.p.m.*	*Free Chlorine*	*< 5 p.p.m*
Magnesium	*< 10 p.p.m.*	*Sodium*	*< 150 p.p.m*
Electrical conductivity	*< 850 µS/cm*	*pH*	*6.5 - 8.5*

c) When using a direct flow system is used in an area with hard water (high mineral content), scale may slowly form in the solar collector loop, gradually reducing performance, increasing pressure drop, and ultimately rendering the system inoperable (due to flow restriction). In such regions, a water treatment system should be installed, which either removes the scale forming minerals, or prevents formation of a scale layer.

Another option is the flush the system with suitable scale removing solution. Any solution used must consider potable water safety and be suitable for use with copper piping.

d) In regions where freeze protection is required, it is advisable to use a closed loop system with a non-toxic grade polypropylene glycol based heat transfer fluid. This liquid should be used directly, or mixed with water as per the manufactures instructions. Periodic inspection of the glycol should be completed (annually), and replaced if necessary ensuring that the liquid mets the requirements outlined in (b) above, or the glycol manufacturer's guidelines for liquid quality and replacement time.

e) Check with local regulations regarding the use of heat transfer fluids as some regions require precautions such as dual wall heat exchangers, back-flow preventers or specific solar system pressure operating levels in order to prevent drinking water contamination.

3.8. Correct System Sizing

The solar collector should normally be sized to provide 90-95% of hot water requirements during summer period. Depending on the location and hot water usage patterns this may provide 40-80% annual contribution to domestic hot water.

3.9. Stagnation and Overheating

a) Stagnation refers to the condition that occurs when the pump stops running, due to pump failure, power blackout, or as a result of a high tank temperature protection feature built into the controller, which turns the solar circulation pump off.

b) If the system is designed to allow wet stagnation as a means of preventing tank overheating, the collector and plumbing in close proximity may reach temperatures of >170°C / 338°F; therefore components that may be exposed to the high temperatures such as valves, plumbing or insulation, should be suitably temperature rated.

c) For direct flow systems, if the system is allowed to stagnate, steam may form in the collector (depending on the system pressure). In such a system, a temperature relief valve or auto air vent should NOT be installed on the collector outlet, as high temperature may damage the valve, and scale formation can rapidly block the vent hole. An exception are air vents that are design to not release steam and that are specifically design for solar system use.

The pressure and temperature relief valve on the tank may open to release pressure or heat as required.

Any heat returning from the collector is generally not enough to cause a continued increase in tank temperatures (i.e. heat input is less than tank heat losses). A crackling noise may be heard in the solar flow and return lines when hot water is used, as the pressure in the system drops and steam forms, this is normal.

3.10. Pressure and Temperature Control and Relief

a) For open loop systems, the normal operating pressure should be <500kPa / 72.5psi via use of a pressure limiting (pressure reduction) valve on the mains cold supply line.

b) For open loop systems, it is acceptable for the system design to allow the solar collector to stagnate to prevent additional heating of the storage tank (i.e. pump stoppage once tank temperature reaches 80°C / 177°F). The pressure relief valve and expansion tank (if installed) must be able to accept/release the pressure increase that occurs when the manifold stagnates, and should be rated to meet the maximum possible heat output of the solar collector(s). See section 3.10 regarding stagnation and overheating.

c) For closed loop systems, the solar loop must operate at <500kPa / 72.5psi, and have an expansion vessel installed to control liquid expansion. The system design MUST NOT allow stagnation of the collector as a standard form of controlling tank temperature, unless the heat transfer fluid is rated for long term exposure to temperatures of up to 200°C.

d) Any system design must provide means for allowing pressure release at no more than 850kPa or 125psi, using a pressure and or pressure and temperature relief valve (PTRV), in accordance with local regulations. THE RELIEF VALVE OR DRAIN TUBE MUST NOT BE SEALED OR BLOCKED

e) If installed inside a building a safe-tray must be installed beneath the hot water tank to safely collect any water expelled from the pressure and temperature relief valve.

3.11. Freeze protection

Freeze protection must be implemented in any regions that experience freezing conditions at any time throughout the year.

a) For areas with temperature **not** falling below –5°C / 23°F, simple low temp controller based freeze protection may be used. (i.e. Pump circulates if the manifold temperature approaches freezing). If possible, backup protection in the form of uninterrupted power supply (UPS) or freeze drip valve (which opens to allow water to dribble out if power supply is cut) should also be installed. It is also important that the tank is heated at least once daily (to the bottom) to ensure there is heat to keep the solar loop from freezing.

b) For areas with temperatures below –5°C / 23°F, a closed loop filled with an anti-freeze mix can be used to provide freeze protection. Please refer to glycol manufacturer's specifications about the temperature ranges the liquid can withstand. See also 1.4 regarding water quality requirements. Anti-freeze liquids are normally required to be potable water grade; please check with local regulations. The other option for cold temperatures is a drain back systems whereby the collector drains empty of water each time the pump stops circulating. The collector and all piping must be suitably sloped (1/4" per foot = 1.2° angle) to ensure full drainage.

c) Apricus does not warrant the solar collector against freeze related damage.

3.12. Wind Loading

a) When installing the collector, wind loading must be considered.

b) The standard frame, and frames kits are all designed to withstand wind speeds of up to 208km/h / 130mph without damage for installation angle of 45^{o} and less. This wind speed corresponds to the mid range of Category 2 cyclones (US Saffir-Simpson Scale). For higher wind speeds additional frame components, lower installation angle and reinforcement of roof attachment may be required. Collector mounting in high wind regions (>208km/h / 130mph) should be reviewed, and where required, approved in writing by a qualified engineer.

c) Refer to section 4 for specific roof attachment details for various frame options.

3.13. Snow Load

a) In areas prone to heavy snow falls the solar collectors should ideally be installed at an angle of 45^{o} or greater to help promote snow sliding off the panel.

b) The solar collectors are able to withstand a maximum snow loading of 300kg/m^2 / 60lbs/ft^2. Ensure that any mounting brackets/stanchion or other framework is suitably rated for expected snow loading. Refer to local regulations regarding snow loading guidelines.

3.14. Hail Resistance

a) The collector glass cover is able to withstand impact from large hail (>∅25mm /1”)

b) In areas prone to large hail (> ∅50mm / ∅3/4”) it is recommended to install at an angle of 45^{o} or greater to provide optimal protection.

c) If the glass is broken the collector will not operate properly and must be replaced.

3.15. Lightning

a) It is advisable to earth/ground the copper circulation loop of the collector to avoid lightning related damage, or electrical safety issues.

4. Collector Mounting

Apricus offer mounting equipment to suit flush mounting on suitable pitched roof as well as installation where an angled mount is required.

⚠ WARNING

- All installations should only be completed on roofs that are in good condition and that can structurally support the collector(s). The mounting points for the collector must always be into structural members such as rafters, trusses or blocking.
- Ensure all roof attachment points are well sealed to avoid water leaks.
- Adhere to relevant local safety regulations when working on roofs.

4.1. Frame Material

a) Main frame components are made from anodised 6005-T5 aluminium which is strong, light-weight and corrosion resistant.

b) Fasteners (bolts, nuts & washers) are made from 316 grade stainless steel.

4.2. Roof Clearance

a) Flush mounted collectors must have a minimum of 50mm / 2” clearance off the roof. This allows ventilation of the roofing material and provides space for rain and leaves etc to pass under the collector.

4.3. Galvanic Reaction

a) Zinc galvanized components should NOT be installed in direct contact with stainless steel bolts or screws, as galvanic reaction between the two metals can cause premature oxidation of the zinc coating and the steel underneath.

b) Avoid using galvanized steel screws or bolts; instead use stainless steel components but ensure the hole in the metal roof is large enough to prevent contact with the stainless steel screw/bolt. If galvanized components are used, avoid direct contact between the two metals by using the rubber/plastic washers under the bolt head.

4.4. Installation Planning

a) Measure the roof and mounting frame to determine the location of the attachment points before completing any roof word. Mark attachment points on the roof with chalk or marker to make the process easier.

4.5. Frame Assembly Process

a) Where possible, attach tracks to the collector at ground level, then carry to the roof.

b) Only gently tighten nuts until attachment to the roof is complete, then hand-tighten all bolts with hand spanner/ wrench or suitably sized socket. If using power socket drivers, set to low speed and adjust to suitable torque setting. If nuts are not smooth when tightening use WD-40 or similar lubricant or anti-gall powder/grease.

c) Do NOT over-tighten stainless steel bolts. Spring washers are provided on each bolt assembly to ensure they do not loosen over time.

4.6. Roof Attachment Strength

a) Frame attachment to the roof should be completed with suitable strength and quantity of stainless steel bolts/ screws.

b) Ensure the mounting surface or ballast is solid and able to withstand the forces that may be encountered during high winds. Refer to local building codes for suitable requirements.

⚠ WARNING

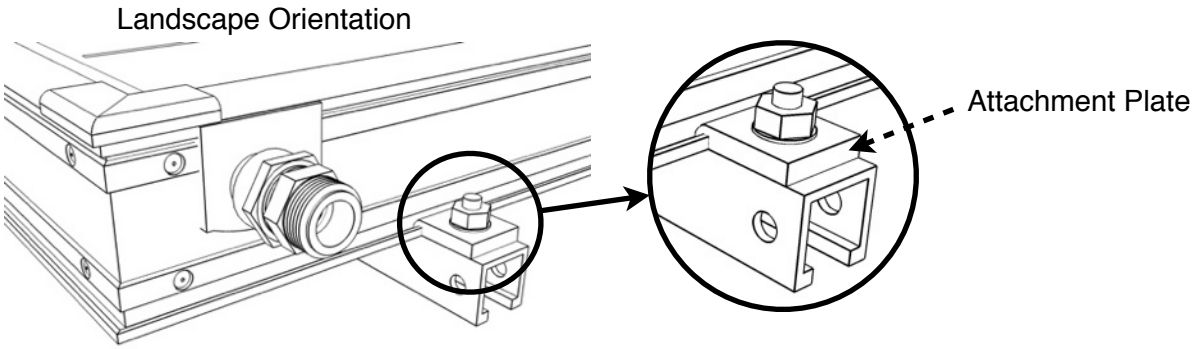
ALWAYS CONSULT BUILDING ENGINEER FOR APPROVAL OF INSTALLATIONS IN HIGH WIND REGIONS.

4.7. Roof Penetrations

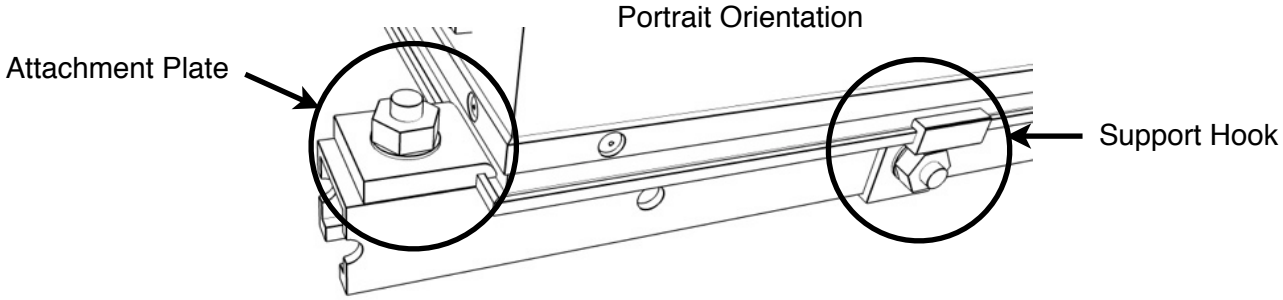
a) If any penetrations in the roof are made they must be waterproofed to prevent water ingress. Commercially available flashing kits are available for different roofing materials.

4.8. Collector Mounting

a) 4 attachment plates (FR-AL-AP-A) are provided with each collector to allow attachment to Apricus frame tracks (vertical or horizontal). The plates are also compatible with most commonly available solar collector mounting rails/ tracks.



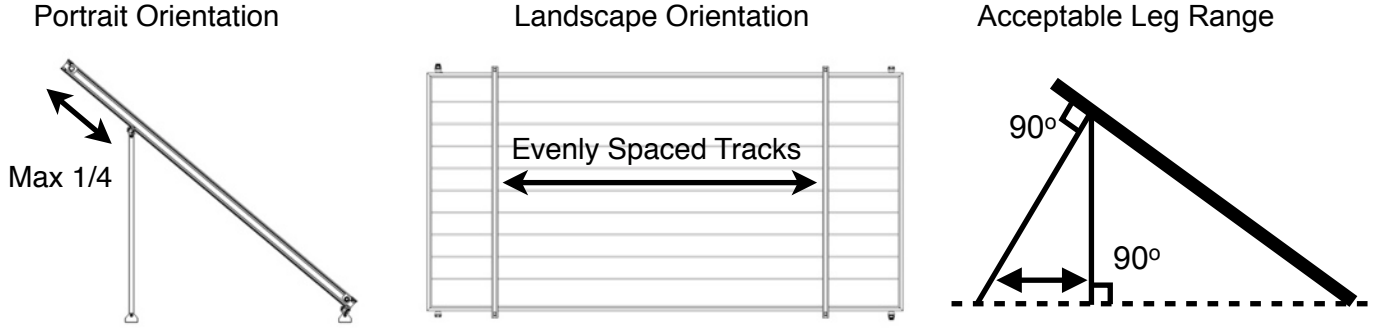
b) When using horizontal tracks, the bottom track sits at a set position at the base of the collectors with support hooks (FR-SS-SP-A) used on the bottom horizontal track to support the weight of the collector and prevent it sliding downwards.



d) Top horizontal track should be located no greater than 1/4 distance in from the top edge of the collector.

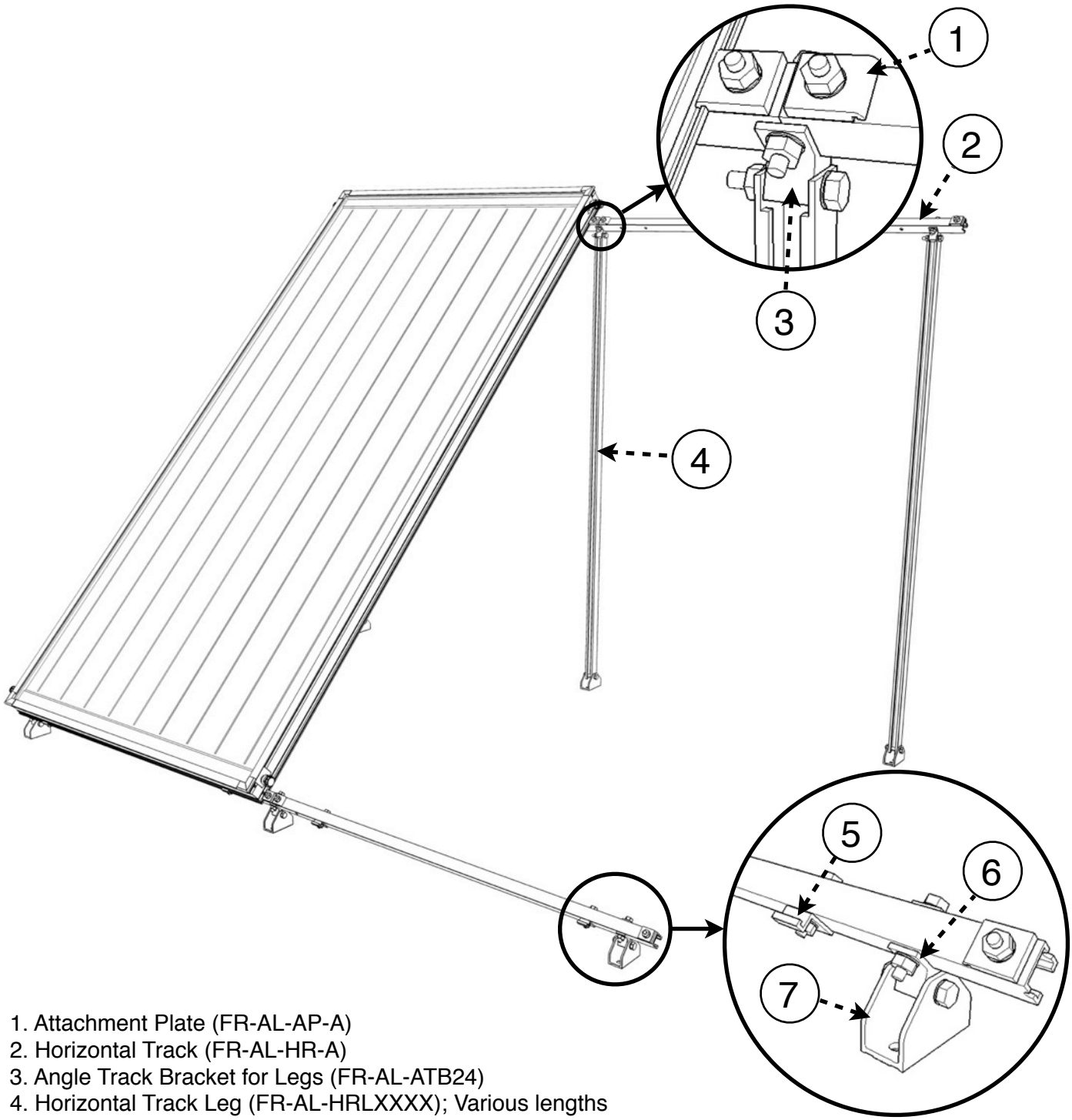
e) For vertical rail orientation, evenly space the rails in from each edge.

b) Rear legs can be used to raise the rear of the collector, and rotated to slightly adjust the installation angle. Acceptable leg range is from perpendicular to the ground/mounting surface to perpendicular with the collector.



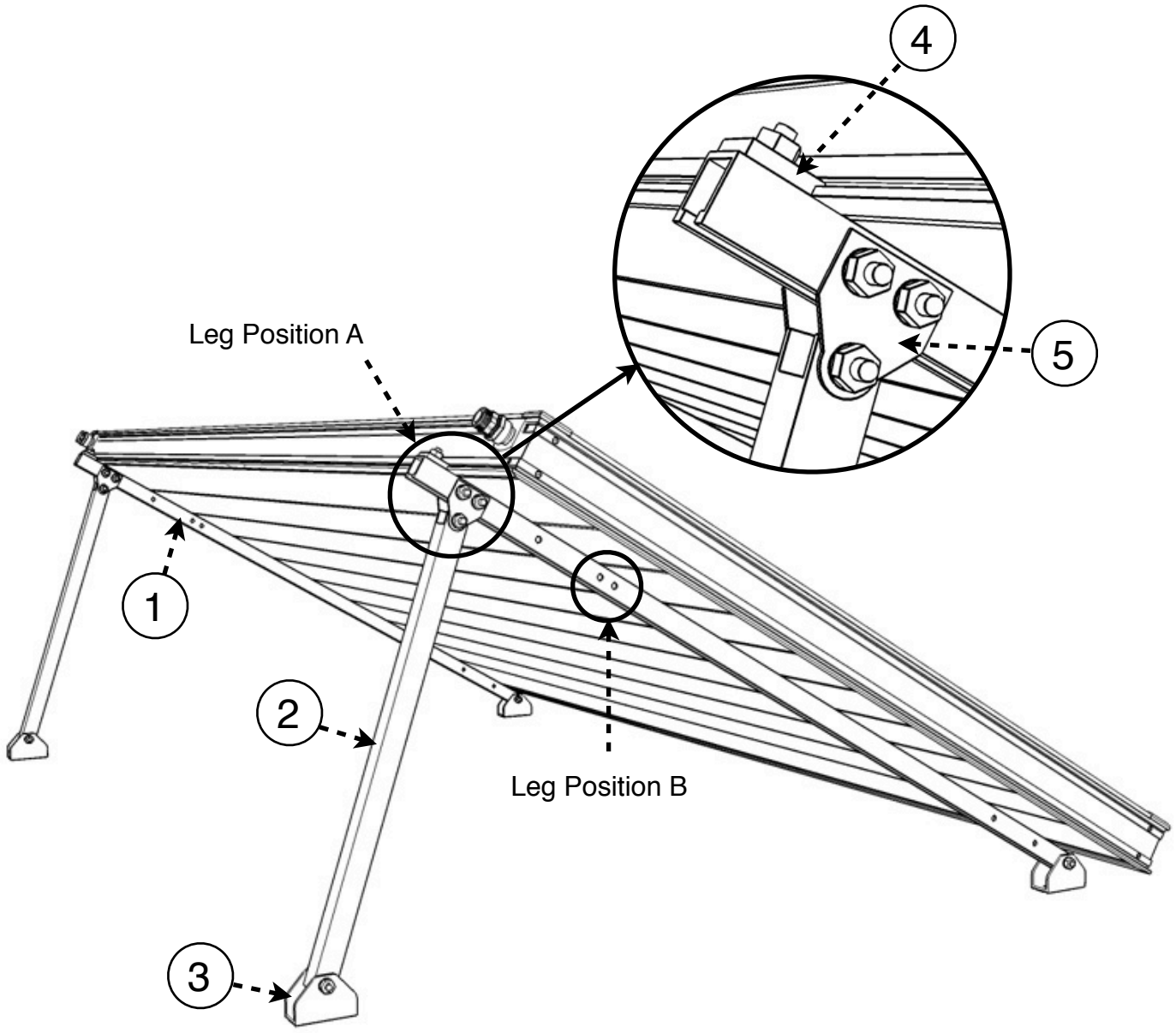
4.9. Frame Components Diagrams

Portrait Orientation Angled Frame Diagram



1. Attachment Plate (FR-AL-AP-A)
2. Horizontal Track (FR-AL-HR-A)
3. Angle Track Bracket for Legs (FR-AL-ATB24)
4. Horizontal Track Leg (FR-AL-HRLXXXX); Various lengths
5. Support Hook (FR-SS-SH-A)
6. Angle Track Bracket for Feet (FR-AL-ATB30)
7. Wide U Foot (FR-AL-UF-6x3-1)

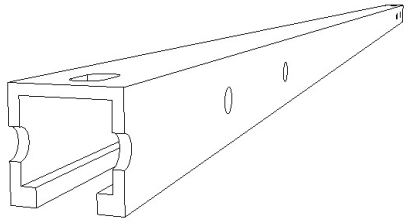
Landscape Orientation Angled Frame Diagram



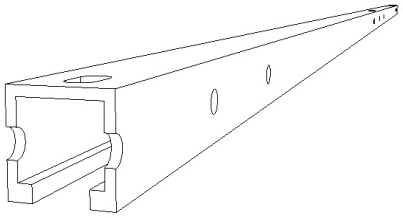
1. Vertical Track (FR-AL-VT-A)
2. Vertical Track Leg (FR-AL-VTLXXXX); Various lengths
3. Wide U Foot (FR-AL-UF-6x3-1)
4. Attachment Plate (FR-AL-AP-A)
5. Triangle Plates & Fasteners included in #2 FR-AL-VTLXXXX

4.10. Frame Component Details

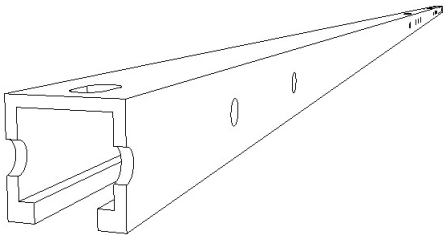
Name: Horizontal Track (Single Panel)
Part #: FR-AL-HT-A
Notes: Aluminium horizontal track for single FPC-A flat plate collector installed in portrait orientation.



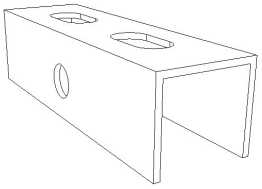
Name: Horizontal Track (Two Panels in Series)
Part #: FR-AL-HT2-A
Notes: Aluminium horizontal track for two FPC-A flat plate collectors installed in series, in portrait orientation.



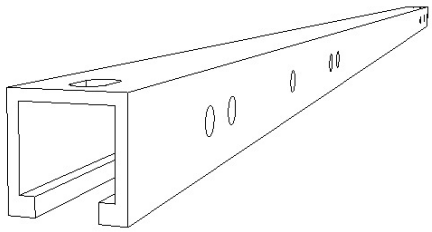
Name: Horizontal Track (Three Panels in Series)
Part #: FR-AL-HT3-A
Notes: Aluminium horizontal track for three FPC-A flat plate collectors installed in series, in portrait orientation.



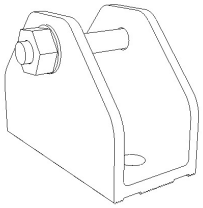
Name: Horizontal Track Connector
Part #: FR-SS-HT-CONN
Notes: Stainless steel connector for joining two horizontal tracks in series.



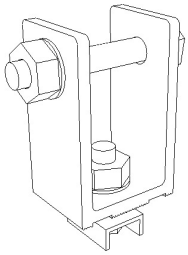
Name: Vertical Track (Single Panel)
Part #: FR-AL-VT-A
Notes: Aluminium vertical track for single FPC-A flat plate collector installed in landscape orientation.



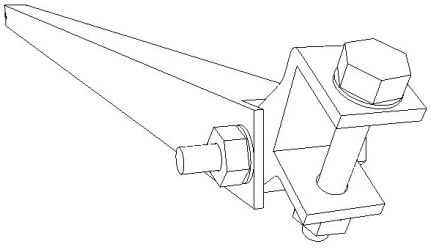
Name: Wide U Foot (For Flat Surface Mounting)
Part #: FR-AL-UF-6x8-1
Notes: Aluminium U shaped mounting foot with wide base for mounting on flat surface.
Supplied with FR-BOLT-M8x50-SW-SPW



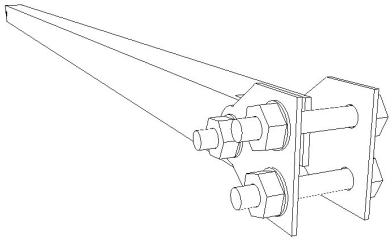
Name: U Foot (for Roof Rail connection)
Part #: FR-AL-UF-6x3-2
Notes: Aluminium U shaped mounting foot for attachment to roof tracks running between front and rear legs. Supplied with FR-BOLT-M8x50-SW-SPW & FR-BOLT-M8x20-SPW-NL



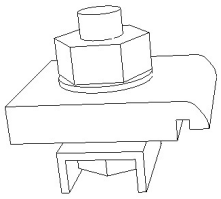
Name: Rear Legs (for Horizontal Tracks)
Part #: FR-AL-HTL<u>XXX</u>-H
<u>XXX</u> = Length of leg in mm (620, 950, 1180, 1660)
Notes: Rear leg supplied with FR-AL-ATB24 and 2 x FR-BOLT-M8x50-SPW-SW for attachment to horizontal rail.



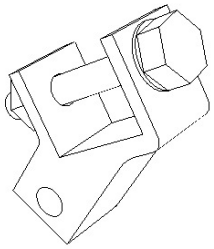
Name: Rear Legs (for Vertical Tracks)
Part #: FR-AL-VTLXXX-V
XXX = Length of leg in mm (400, 620, 950, 1180, 1660)
Notes: Rear leg supplied with 2 x FR-AL-TP & 3 x FR-BOLT-M8x50-SPW-SW for attachment to vertical track.



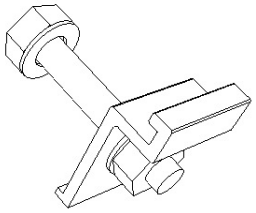
Name: Attachment Plate (supplied with collector)
Part #: FR-AL-AP-A
XXX = Length of leg in mm (400, 620, 950, 1180, 1660)
Notes: Attachment plate for FPC-A collectors, compatible with Apricus and most standard tracks/rails.
Supplied with FR-BOLT-M8x20-SPW-BW-NL.



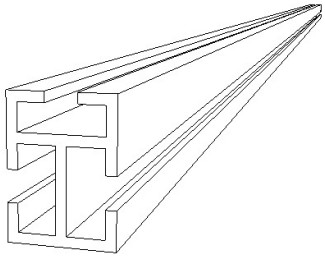
Name: Angled Track Bracket (For Bottom Track)
Part #: FR-AL-ATB24
Notes: Aluminium bracket to connect bottom horizontal track to a U Foot.
Supplied with FR-BOLT-M8x50-SPW-SW



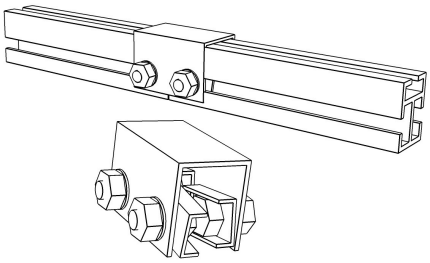
Name: Support Hook
Part #: FR-SS-SH-A
Notes: Stainless steel hook for attachment to bottom horizontal rail to help support flat plate. Supplied with FR-BOLT-M8x50-SPW-SW.



Name: XL Roof Rail
Part #: FR-AL-XLRR
Notes: Aluminium heavy duty horizontal roof rail with both top and side slide channels for FR-AL-TF foot attachment. Ideal for commercial projects where multiple collector are installed in series.



Name: XL Roof Rail Connector
Part #: FR-AL-XLRR-CONN
Notes: Connects XL Roof Rails end to end. Supplied with 4 x FR-BOLT-M8x20-SPW-NL.

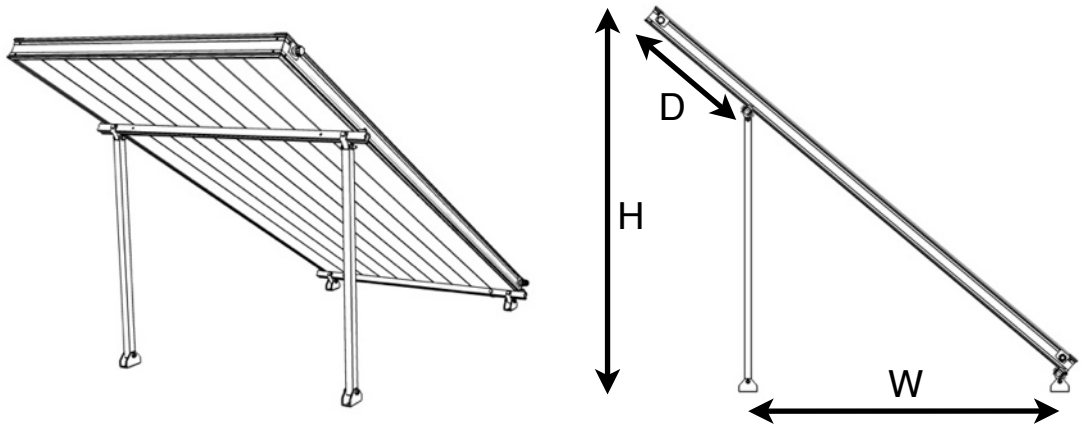


4.11. Angled Frame Guide

a) When the mounting surface is not of sufficient angle/pitch, a set of rear legs can be used to raise the rear of the panel.

b) Collectors are normally installed in the portrait orientation. Horizontal tracks allow both the leg spacing (W) and position of the rail behind the flat plate (D) to be adjusted, provided flexibility in installation angle. Horizontal tracks also allow shared middle legs to be used when installing 2 or more collectors in series.

Portrait Orientation



FPC-A26 Portrait Orientation

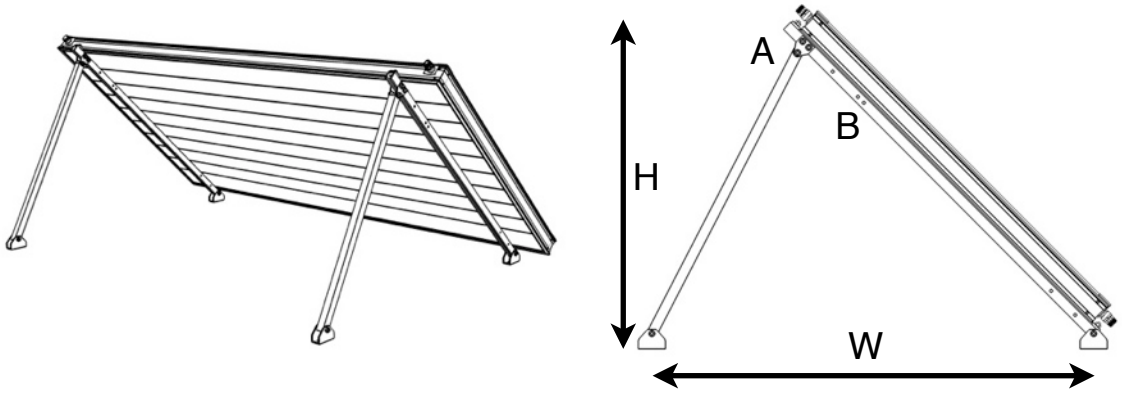
Angle	Leg [1]	H	D [2]	W [3]
20°	FR-AL-HTL620	836mm / 33”	190mm / 7.5”	1696mm / 67”
30°	FR-AL-HTL950	1137mm / 45”	75mm / 3”	1687mm / 66.5”
40°	FR-AL-HTL950	1407mm / 55.5”	486mm / 19”	1187mm / 46.5”
50°	FR-AL-HTL1180	1639mm / 64.5”	429mm / 16.9”	1071mm / 42.2”
60°	FR-AL-HTL1180	1815mm / 71.5”	593mm / 23.5”	768mm / 30”

FPC-A32 Portrait Orientation

Angle	Leg [1]	H	D [2]	W [3]
20°	FR-AL-HTL620	995mm / 39”	645mm / 25.5	1697mm / 67”
30°	FR-AL-HTL1180	1368mm / 54”	77mm / 3”	2103mm / 83”
40°	FR-AL-HTL1180	1704mm / 67”	590mm / 23”	1479mm / 58”
50°	FR-AL-HTL1660	1993mm / 78.5”	382mm / 15”	1514mm / 59.5”
60°	FR-AL-HTL1660	2215mm / 87”	503mm / 20”	1086mm / 43”

c) If landscape orientation is used, vertical tracks are used. In this format the tracks have a choice of two attachment points for the rear leg, A & B.

Landscape Orientation



FPC-A26 & 32 Landscape Collector Orientation

Angle	Leg Part	H	Leg Position	W
20º	FR-AL-VTL400	520mm / 20.5”	A	1174mm / 46”
30º	FR-AL-VTL620	710mm / 28”	A	1242mm / 49”
40º	FR-AL-VTL620	842mm / 33”	B	820mm / 32.5”
50º	FR-AL-VTL950	1050mm / 41.5”	A	1304mm / 51”
60º	FR-AL-VTL950	1172mm / 46”	B	948mm / 37.5”

4.12. Wall Mounting

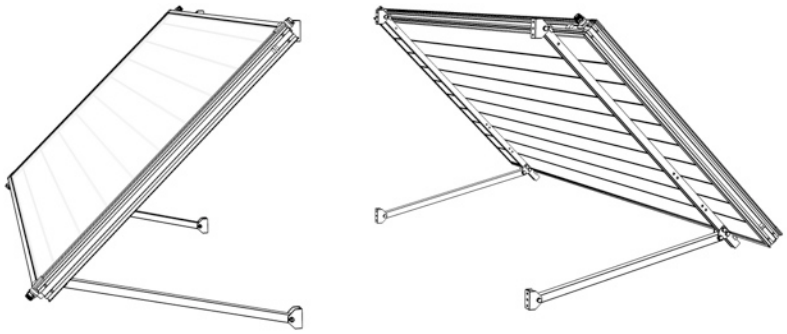
a) The collector may be mounted flush on a wall, or at an angle with the bottom of the collector angled away from the wall using the standard angled frame kits.

c) The method used for attachment to the wall will depend on the wall material.

- For brick or concrete walls use expansion bolts.
- For wood or metal framing use screws of suitable strength.

d) Ensure the wall attachment points are able to withstand the weight the wind loading that the collector will apply to the attachment points.

e) When installing on a wall consider the possible shading from eves, particularly in the summer when the sun is high in the sky.



5. Piping & Collector Layout

5.1. Flow Rate

a) Temperature rise through the collectors depends on the flow rate, solar radiation levels, ambient temperature and solar collector temperature. Where possible use variable speed pump control to achieve a set temperature rise.

c) If using a fixed flow rate, it is recommended to aim for ~15°C / 27°F temperature rise in peak output conditions, as presented in the table below.

Flow Rate (L/min)	Temp Rise (°C) *		Flow Rate (US Gpm)	Temp Rise (°F) *	
	FPC-A26	FPC-A32		FPC-A26	FPC-A32
	1706 Watt Peak Output	2114 Watt Peak Output		5820 Btuh Peak Output	7212 Btuh Peak Output
1	24	30	0.25	47	58
2	12	15	0.5	23	29
3	8	10	0.75	16	19
4	6	8	1	12	14
5	5	6	1.25	9	12

* Peak collector output at midday, G=1000W/m^2 / 317Btu/ft^2

5.1. Pipe Size

a) As a general rule piping should be chosen to achieve a maximum flow speed of 1m/s / 3.3ft/s, which based on the header and riser pipe diameters, limits the total maximum flow-rate through any FPC-A model collector to ~15L/min / 4 US Gpm.

b) For domestic heating applications with 1 or 2 collectors, nominal DN15 / ½" piping is suitable.

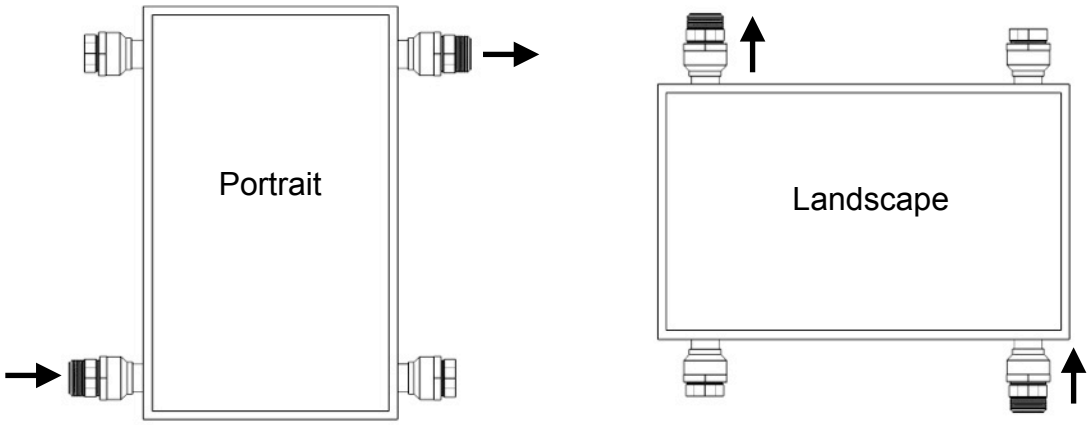
c) For applications using 2 - 8 collectors in series or parallel, it is advisable to use a nominal DN20 / 3/4" piping.

d) For larger projects the pipe sizes should be chosen based on maximum flow rates and pressure drop considerations.

5.2. Single Collector Connection

a) For a single collector, only two of the ports are used for liquid flow, the other two are plugged. In portrait orientation the outlet is the top right port, when in landscape orientation the outlet is top left port. The outlet port is also the location of the temperature sensor port.

b) Two ports are plugged using the Apricus supplied component BF-PLUG-FL19, and depending on the location, the inlet and outlet use BR-SF-FL19x3/4"MBSP, or other suitable Apricus fitting that allows connection to the system piping.

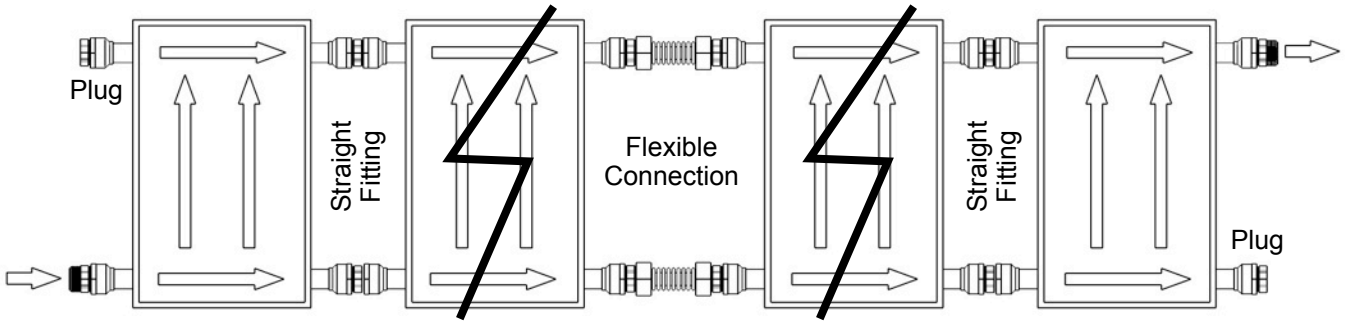


5.3. Connection of Multiple Collectors

a) Up to 10 x FPC-A collectors may be connected in series. In such a configuration only two ports are plugged, as shown in the diagram below.

b) A maximum of 5 collectors may be connected in series with a straight (non-flexible) connectors as supplied by Apricus, part *BF-ST-FL19xFL19*.

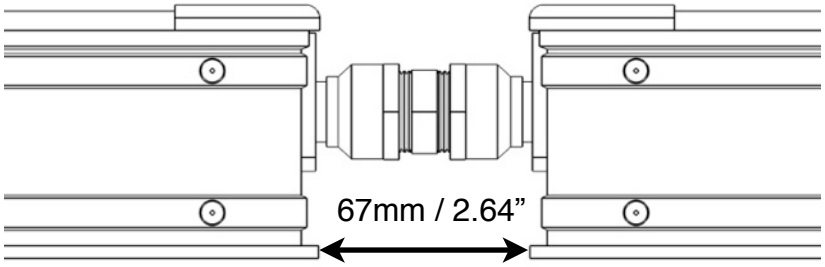
c) For more than 5 collectors in series a flexible connection with ability to compress/extend by 25mm / 1” from resting length at 20°C / 68°F must be installed every 5 collectors.



d) Apricus does not warrant the collector against damage resulting from poorly managed header expansion and contraction.

e) When installing multiple collectors in series, landscape orientation is not recommended as a U shaped pipe connection between consecutive collectors can be a source of air locks and increased pressure drop.

f) When connecting multiple collectors in series, spacing is 67mm / 2.64” measured from the bottom edge of the collector box.



5.4. Pipe Insulation

a) Heavily insulate all piping running to and from the collector with a high quality insulation of at least 13mm/0.5” thickness, preferably thicker in cold climates.

b) Insulation foam that is exposed to direct sunlight should be protected against UV related degradation by wrapping/covering with a suitable material such as adhesive backed aluminum foil, PVC conduit or similar.

c) Ensure that the insulation tightly covers the inlet/outlet ports and is sealed against the collector body with silicone sealant or foil tape to prevent water ingress.

d) For systems designed to allow dry stagnation (such as drain back systems), high temperature rated insulation such as glass wool or mineral wool should be used on piping close to the collector (~2m / 6’). Glass wool will readily absorb water so must be wrapped with watertight and UV resistant layer such as fibre reinforced aluminium foil.

5.5. Air Purge

a) Once the inlet and outlet are connected to the plumbing system, the collector loop should be purged of air.

b) Mains Pressure Direct Flow:

- Without Air Vent: Install a drain valve on the return line (collector > tank) ball valve between the drain valve and the tank. With the ball valve closed open the drain valve allowing air to escape as the mains pressure water forces through the solar collector line. If the collector is hot steam and hot water may be expelled to extreme care should be taken! Once the drain valve is no longer releasing air it can be closed and the ball valve opened so that normal operation can begin.

- With Air Vent: With the air vent installed on the return line (collector > tank), isolate the return line after the air vent with a ball valve allowing the mains pressure water to purge the collector of air. Always remove or isolate the air vent after the air purge.

c) Low Pressure Direct Flow:

- Run the pump at the highest speed settings, forcing air out of the collector and back into the tank.
- If an auto-air vent is installed on the outlet of the collector, air will be automatically eliminated from the solar line. If using a manual air vent this should be opened until all air is eliminated.
- Always remove or isolate the air vent after the air purge unless specially design to remain in place.

d) Closed Loop:

- The solar loop should be filled with glycol/water mix (or suitable heat transfer fluid), vented and pressurised. The exact process will depend on the design of the loop and components used. Refer to relevant instructions specific to the pump station and filling equipment used.

e) One the system is purged of air a check for leaks at all connection points should be completed. For closed loop systems the system should be pressure tested prior to air-purge process.

5.6. Pump Selection

a) Pump should be selected to meet the following requirements:

- Flow-rate: Based on the number of collectors, desired temperature rise, climate etc.
- Head pressure: Select a pump that has sufficient heat pressure to overcome the pressure drop of the solar collector, flow and return lines at the desired flow-rate. For drain-back systems the vertical distance from the drain-back tank to the collector must also be considered.
- Material: For closed loop systems a cast-iron body pump can be used. For direct flow systems a brass/bronze or stainless steel body pump is recommended.

b) Where possible use a controller with variable speed pump control so that flow rate can be adjusted to achieve the desired temperature rise. The table below provides the temperature rise at different flow rates based on collector midday peak output when (when tm - ta delta-t = 0).

c) Use a flow meter/setter to confirm the flow-rate through the system.

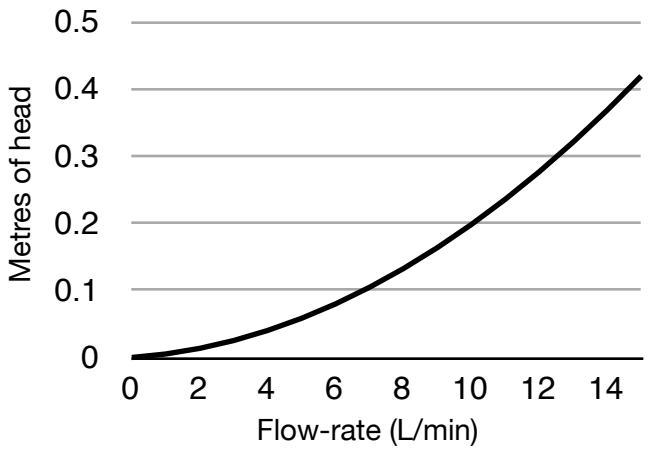
d) If the system is not achieving the desired flow, troubleshooting can include:

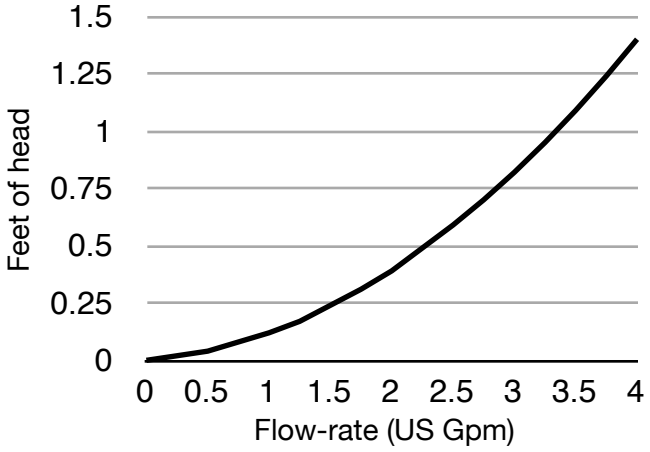
- Checking for an air lock in the collector or flow and return lines; repeat air-purge process.
- Check operation of the non-return valve.
- Pump may not be bled of air, or may be cavitating due to installation issues.
- Pump may not have sufficient head pressure to overcome the line losses.

e) Always use hot water rated pumps (up to 110°C / 232°F), or specified by the supplier as suitable for solar.

f) Always install the pump on the cold line (tank > collector). The pump should have an integrated non-return valve, or brass non-return installed after the pump to prevent reverse flow of high temperature liquid which could damage the pump.

5.7. Pressure Drop Graphs (FPC-A32)





6. System Control

6.1. Controller

a) The most common means of controlling a solar thermal system is through use of a controller that measures solar collector and storage tank temperatures and manages power supply to the circulation pump(s) and any valves.

b) It is also possible to have a system that uses a DC circulation pump powered directly by a PV panel in which case a controller may not be required. Such systems must be designed to manage temperature, pressure and freezing (where applicable) in a reliable and safe manner.

6.2. Temperature Measurement

a) The outlet port of the FPC-A solar collector has a copper sensor port that accepts standard 6mm diameter sensor probes.

b) Ensure that sensors used on the collector are high temperature rated (up to 200°C / 395°F), including the cable which should be made from silicone rubber.

c) If multiple collectors are installed in series, install in the outlet of the last collector.

c) Do not allow the sensor cable to come in direct contact with the metal solar flow or return lines, as the heat may damage the cable. The sensor cable should run along the outside of the insulation pipe, wrapped with aluminium foil to secure in place and protect from UV exposure.

d) Following these steps to install the sensor:

STEP 1: Wet the sensor tip and cable with water.

STEP 2: Slide on the rubber sensor plug.

STEP 3: Coat the sensor probe with heat transfer paste.

STEP 4: Insert the sensor into the sensor port and push rubber plug into place

STEP 5: Use cable ties to secure the cable in place against the insulation pipe.

6.3. Solar Controller Settings

a) For solar controllers the following solar ON/OFF settings are usually appropriate:

Delta-T ON = 8°C / 14°F; Delta-T OFF = 2°C / 3.6°F

These settings may need to be altered according to the location and system design. Refer to the controller installation manual for more information.

7. Maintenance

Under normal conditions the solar collector is maintenance free. Other system components such as the pump, glycol liquid (if used) may require periodic inspection and changing/maintenance. Please refer to the documentation provided by the manufacturer of these other components.

⚠ WARNING
APART FROM THOSE MAINTENANCE ITEMS OUTLINED BELOW, ANY SYSTEM INSPECTION, MAINTENANCE OR REPAIR SHOULD ONLY BE COMPLETED BY AUTHORISED PERSONS. THE SOLAR COLLECTOR WARRANTY COVERAGE MAY BE VOID IF NON-AUTHORISED PERSONS ATTEMPT TO MAINTAIN OR REPAIR THE SOLAR COLLECTOR OR ASSOCIATED COMPONENTS. **HOME OWNER MAY ONLY COMPLETE THOSE MAINTENANCE ACTIVITIES OUTLINED IN THIS DOCUMENT IF SAFE TO DO SO.** **HOME OWNER MUST NEVER CLIMB ONTO A ROOF.**

The following maintenance may be completed by HOME OWNER

7.1. Cleaning

a) If the glass panel become dirty they may be cleaned with high pressure water or glass cleaner.

b) Leaves may accumulate between or beneath the collector panel and should be removed. The solar collector is NOT a heat source that could ignite the leaves during hot weather.

7.2. Other Components

Other system components such as the pump station or controller may have certain maintenance functions that can be safely completed by the Home Owner. Refer to the owner's manuals for those components for more information.

The following maintenance may ONLY be completed by AUTHORISED PERSONS

7.3. Insulation

a) The plumbing pipes running to and from the collector should be heavily insulated. This insulation foam should be checked periodically (at least once every 3 years) for damage.

b) For any insulation that is exposed to sunlight, ensure any protective cover/wrap/foil is in good condition, replacing as required.

7.4. Broken Glass Cover

a) If the solar collector glass cover is broken the entire solar collector must be replaced.

7.5. Draining the Collector

a) Draining of the collector may be required if maintaining the system or in preparation for extremely cold conditions (extended snow cover). In order to drain the collector of fresh water (direct flow system):

STEP 1: Turn off the mains water supply to the solar storage tank. If the storage tank or other system components are being concurrently drained, refer to their instruction manuals for details.

STEP 2: If storage tank is not being drained, isolate piping to and from the solar collector (isolation valves should already be installed), and immediately open drain valves on both lines (or undo fittings). Never leave the isolation valves in the off position while the collector is full of water and exposed to sunlight as the water will heat cause a pressure increase which may rupture fittings/connections. In good weather the water may be hot or have built up pressure, so take care when opening the drain valve.

STEP 3: Allow the collector to sit in a vented state for 5-10min to allow the manifold to boil dry (may need longer in poor weather).

STEP 4: Always leave one drain valve or fitting open, otherwise the system may build up pressure when it heats up.

b) For draining of other types of systems, please refer to specific instructions for the system used.

7.6. Other Components

Other parts of the system such as the pump and storage tank (electric or gas water heater) should be serviced/ inspected according to their manufacturer's own maintenance guidelines.

8. Troubleshooting

Those inspection items with an (**H**) in front may be completed by the home-owner, but only if such investigation is clearly both SAFE and EASY. Any information obtained during an investigation can then be relayed onto the company who supplied and installed the system. Any other system troubleshooting, system adjustments, or repairs may only be completed by authorised persons.

The following table includes a range of troubleshooting possibilities covering Closed Loop (CL) and Direct Flow (DF) systems. Items that are specific to one type will have (CL) or (DF) in front.

Problem	Cause	Solution
Pump not ON during good solar radiation conditions	Temperature sensors not working properly	• Check that sensor is installed correctly • Check that sensor wire is not damaged • Swap sensors to confirm temperature reading
	Incorrect controller settings	• Check controller settings **(H)**
	Controller Max Temp or Max Collector setting reached	• Check maximum tank and collector settings **(H)**
Pump cycling ON and OFF during good solar conditions	Partial shading of collector	• Check collector location for shading **(H)**
	Excessive system flow rate	• Adjust restrictor screw on flow setter • Reduce pump speed (select slower speed)
	Controller settings incorrect	• Solar off (delta-t) value may be set too high. **(H)**
Pump always ON even during minimal solar radiation conditions	Insufficient flow rate	• Check flow gauge for proper flow rate **(H)** • Adjust restrictor screw on flow setter **(H)** • Clean any in-line filters • Check non-return valve operation and pipe for obstructions. • (CL) Check heat transfer fluid pH, color and viscosity, may need to be flushed and replaced.
	Air lock in piping system	• Purge system of air by following Air Purge procedures
	Bottom tank sensor not getting accurate reading.	• Check operation of sensor. Should be getting accurate ready of low tank temperature. • Ideal position of low tank sensor is ABOVE level of solar flow (tank to solar) port.
	Controller settings incorrect	• Solar off (delta-t) value may be set too low. **(H)**
Pump running at night	Controller settings incorrect	• (DF) Check that freeze protection setting is correct. Intermittent circulation is freezing conditions is normal. Ensure pipes are well insulated. **(H)**
	Bottom tank sensor not getting accurate reading.	• Check operation of sensor. Should be getting accurate reading of low tank temperature. • Ideal position of low tank sensor is ABOVE level of solar flow (tank to solar) port.
Fluid dumping from pressure relief valve on pump station	Faulty pressure relief valve	• (CL) Replace pressure relief valve
	Faulty expansion tank	• (CL) Replace expansion tank on pump station
	Undersized expansion tank	• (CL) Install larger expansion tank
System pressure dropping too low when system is cold.	High expansion tank pressure setting	• (CL) Set expansion tank pressure slightly below cold fill system pressure.
Fluid dumping from pressure relief valve on tank	Excessive tank temperature	• Check Max Tank setting of controller **(H)** • Check tank sensor operation (that measures top tank temp)
	Faulty expansion tank	• Replace expansion tank on potable water side

Problem	Cause	Solution
Poor Solar Heating Contribution (Compared to previous output at same time of year)	Increased hot water demand	• Check if hot water demand has increased, which would reduce the % contribution from solar even with the same level of output. **(H)**
	Insufficient flow rate	• Check flow gauge for proper flow rate **(H)** • Adjust restrictor screw on flow setter **(H)** • Clean any in-line filters • Check non-return valve operation and pipe for obstructions. • (CL) Check heat transfer fluid pH, color and viscosity, may need to be flushed and replaced.
	Partial shading of collector	• Check collector location for shading or snow coverage. **(H)**
	Dirty glass	• Clean glass. Refer to Maintenance section for safety instructions. **(H)**
	Damaged insulation	• Check that insulation is still in good condition with no exposed pipe. **(H)**
	Heat pipes not operating	• Check that heat pipes are making good contact in header, and are hot at the tip.
	Scale build up in collector header or external heat exchanger.	• (DF) Back flush solar collector loop with scale cleaning liquid. Install scale inhibitor. • (CL) Back flush external heat exchanger with scale cleaning liquid.
	Insufficient pump run time	• For normal ON/OFF pump operation (not variable speed) ensure the pump is running long enough for the heat from the collector to return to tank - feel return line with hand (careful) to check. Reduce solar off (delta-t) value slightly.
	Pump cycling too long and dissipating heat	• Solar off (delta-t) value may be set too low. **(H)** • Tank bottom sensor too low in tank, always reading cold water. Move to correct location above tank to solar port.
Tank cooling down at night. It is normal for tank to loose 0.3 - 0.4ºC/ hour depending on tank and ambient temps.	Thermo-siphoning	• System may be “core” or “reverse’ thermo-siphoning at night. Install sprung check valve on return (collector to tank) line close to tank or install U shaped heat trap in piping.
	Excessive tank heat losses	• Insulate both the hot and cold water pipes connected to the storage tank. **(H)** • Insulate any exposed fittings and valves on the storage tank. DO NOT impair the operation of the PTRV. • Add a layer of insulation to the outside of the tank. **(H)**
Not enough hot water	IF ELECTRIC Electric not heating water	• Check operation and power supply to element. May be on timer? • Check if element is on off-peak power supply. Any changes? **(H)** • Replace element if faulty • Check controller boost settings (if controller managed) **(H)**
	IF BOILER or GAS TANKLESS Booster not heating water	• Check gas/fuel supply **(H)** • Check operation of boiler/heater • Check controller boost settings **(H)** • Check circulation pump (if heated by boiler)
	Faulty tempering valve, mixing the water too cold	• Check operation of tempering valve
	Increased hot water demand	• Install larger capacity boiler/booster • Revise boost settings of controller or timer **(H)** • Install larger storage tank
Intermittent short patches of cold water when showering	Faulty tempering valve	• Check operation of tempering valve
	Faulty tankless gas booster operation (if post gas system)	• Check operation of tankless gas booster

9. Disclaimer

Apricus Solar Co., Ltd withholds the right to change dimensions and the characteristics of the product without any forewarning, and rejects any kind of responsibility for misprints.

This booklet is only a guide and as such Apricus Solar Co., Ltd will not be held responsible for any damage to person or property that results during the installation or subsequent use of this solar collector and related system components.

10. Manufacturer's Limited Warranty

Apricus FPC-A Flat Plate Solar Collector 10 Year Limited Warranty

GENERAL

Apricus warrants the FPC range of flat plate solar collectors (the "Products") to be free from defects in workmanship under normal usage for the applicable Warranty Period from the date of installation. This Limited Warranty extends to the End-User of the product at the original installation location, and is not transferable.

In the event of a defect, malfunction or other failure of the Products occurring within the applicable Warranty Period which is not caused by any misuse or damage to the Product while in the possession of the End-User, Apricus will remedy the failure or defect within a reasonable amount of time. The remedy will consist of repair or replacement of the Products, or refund of the purchase price, in Apricus's sole discretion. However, Apricus will not elect to refund the purchase price unless it is unable to provide a replacement, and repair is not commercially practical and cannot be made within a reasonable timeframe. After a reasonable number of attempts by Apricus to remedy any defects or malfunction, the End-User will be entitled to either a refund or replacement of the product or its component parts. The remedies stated herein are the sole remedies for defects within the applicable warranty period.

WARRANTY PERIOD

The "Effective Date" of warranty coverage is the installation date as recorded on the installation record form, purchase invoice date, or, if neither are available, the date of manufacture plus sixty (60) days.

LIMIT OF LIABILITY

EXCEPT FOR THE EXPRESS LIMITED WARRANTY PROVIDED FOR HEREIN APRICUS HEREBY DISCLAIMS AND EXCLUDES ANY AND ALL OTHER WRITTEN OR ORAL EXPRESS WARRANTIES OR REPRESENTATIONS. ANY IMPLIED WARRANTY OF MERCHANTABILITY OR IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE MUST ARISE UNDER STATE LAW TO APPLY, AND IS HEREBY LIMITED IN DURATION TO THE DURATION OF THE WRITTEN LIMITED WARRANTIES PROVIDED HEREIN UNLESS OTHERWISE BARRED BY ANY APPLICABLE STATUTE OF LIMITATION. APRICUS DISCLAIMS ANY RESPONSIBILITY FOR SPECIAL, INDIRECT, SECONDARY, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING FROM OWNERSHIP OR USE OF THESE PRODUCTS, INCLUDING PERSONAL INJURY, INCONVENIENCE, LOSS OF USE OR LOSS OF INCOME. NO AGENT OR REPRESENTATIVE OF APRICUS HAS ANY AUTHORITY TO EXTEND OR MODIFY THIS WARRANTY UNLESS SUCH EXTENSION OR MODIFICATION IS MADE IN WRITING BY A CORPORATE OFFICER. WHERE ANY DISCLAIMERS AND LIMITATIONS CONFLICT WITH APPLICABLE STATE LAW, APPLICABLE STATE LAW SHALL PREVAIL.

Some states do not allow the exclusion or limitation of incidental or consequential damages and some states do not allow limitations on how long implied warranties may last, so the above limitations may not apply to you.

WITH RESPECT TO ANY END-USER OTHER THAN A CONSUMER END-USER WHICH PURCHASES APRICUS PRODUCTS FOR COMMERCIAL, INSTITUTIONAL, INDUSTRIAL OR OTHER NON-RESIDENTIAL PURPOSES, APRICUS DISCLAIMS ANY IMPLIED WARRANTY OF MERCHANTABILITY OR IMPLIED WARRANT OF FITNESS FOR A PARTICULAR PURPOSE AND FURTHER DISCLAIMS ANY LIABILITY FOR SPECIAL, INDIRECT, SECONDARY, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING FROM OWNERSHIP OR USE OF THESE PRODUCTS, INCLUDING PERSONAL INJURY, INCONVENIENCE, LOSS OF USE OR LOSS OF INCOME.

Apricus assumes no responsibility under this Limited Warranty for any damage to the Products caused after they have left the control of Apricus, including but not limited to damages caused by any trades people or visitors on the job site, or damage caused as a result of post-installation work. This Limited Warranty shall be invalidated by any abuse, misuse, misapplication or improper installation of the Products.

WARRANTY EXCLUSIONS

This warranty does not cover:

(a) Any other components in the solar system beyond the Products as defined in this warranty document;

(b) Failure of the Product where the design or structure of the Products are attempted to be modified or altered in any way, including by not limited to attaching non-Apricus approved appliances or equipment, defacing the serial tag or other identification, or relocating from its original point of installation;

(c) Products that are not installed, repaired or maintained by suitably qualified and licensed persons and in accordance with applicable local codes and the Apricus Product Installation Manual;

(d) Failure of the Product due to excessive system pressure, temperature, electrochemical reaction, air impurities, vandalism, wind, hail, snow, storms or other acts of God;

(e) Solar collector is exposed to flow rates in excess of 15Lpm / 4gpm;

(f) Failure of the Product due to freezing or corrosion;

(g) Failure of the Product due to use of water or heat transfer liquids that are not within specified quality limits, or non-approved.

(h) Damage to the collector header caused by heat buckling;

(i) Failure or loss of efficiency is due to lime-scale formation;

(j) Any condensation or similar resulting from the normal intrusion of moisture into the collector;

(k) Any application other than medium temperature (<80ºC / 176ºF) water heating.

(l) Failure of the Product where any operation exceeds the documented design limits of the system components or materials.

END USER OBLIGATIONS

In order to obtain performance of any obligation under this warranty, the End-User must:

(a) Firstly determine if the Product is within the applicable Warranty Periods. This can be determined by referring to the installation record form, or alternatively the original purchase invoice. If neither documents are available, the serial number and manufacturing date will need to be read off the Product serial tag. Some Products may be installed in a location that is not accessible to the End-User and so the information may only be obtained by a qualified service technician.

(b) Contact the company who installed the original Product, or, if unknown or unable to be contacted, contact Apricus directly.

The following information may be required to determine if the Product issue is eligible for coverage under the terms of this Limited Warranty.

(i) Information related to the manner in which the Product(s) were installed.

(ii) The history of operation.

(iii) Any repairs that may have been made.

(iv) Evidence that the Product(s) were installed by a qualified, licensed contractor.

(v) Evidence that the Product(s) were installed in accordance with the applicable Product Installation Manuals and any special written design or installation guidelines by Apricus for this project.

(vi) Evidence that the Product(s) were installed in accordance with all applicable local building, plumbing and electrical codes.

CUSTOMER SATISFACTION

We believe you will be fully satisfied by the service you receive from the local Apricus representatives and from Apricus. However, because our aim is your complete and lasting satisfaction, Apricus adds another feature to your warranty's protection. In the unlikely event that you feel our response to a warranty service request is not satisfactory, Apricus offers you an opportunity to air your complaint in an impartial Mediation process.

The opportunity to mediate any complaint made by an End-User is hereby extended to all End-Users. If you are a Consumer End-User, the provisions of the federal Magnuson-Moss Warranty Act provide that you may not file suit against Apricus until your claim has been submitted to Mediation for an informal dispute settlement and a decision has been reached.

11. Installation Record Form

Apricus Customer Installation Record Form

Thank you for choosing Apricus.

The following form should be completed by the Installer and Home Owner to keep as a record of the installation in case of a warranty claim. Please also register details at www.apricus.com.

Customer's Name:	
Address of Installation:	
Date of Product Installation:	
Installer's Name:	
Installation Company Name:	
Installation Company Ph:	
Product Serial Number(s):	
Comments:	
Signed by Installation Officer:	
Signed by Customer:	

IMPORTANT NOTES:

1. Please only sign if you are happy with the service provided by the Installer and the system is working properly.

2. Keep this document as a record of the installation as it will be required in the case of any warranty claims.