Delivering Sustainable Hot Water Solutions

AP Solar Collector

Installation & Operation Manual

International Edition - V18 - June 2014

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 AP evacuated tube solar collector. 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-authorized 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 "authorized 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 the Apricus solar collector may be inspected, repaired or maintained by anybody other than an authorized person(s).

1.4. Collector Dimensions & Weights

Not all models listed below are available in all markets.

Collector Size	10 tubes	18 tubes	20 tubes	22 tubes	30 tubes
Overall Length [1]	2005mm / 80"				
Overall Height	136mm / 5.35" (manifold only) 154mm / 6.06" (manifold + standard frame)				
Overall Width [2]	796mm / 31.3"	1356mm / 53.4"	1496mm / 58.8"	1636mm / 64.4"	2196mm / 86.4"
Aperture Area [3]	0.94m^2 / 10.1ft^2	1.69m^2 / 18.2ft^2	1.88m^2 / 20.2ft^2	2.07m^2 / 22.3ft^2	2.83m^2 / 30.4ft^2
Gross Area	1.59m^2 / 16.95ft^2	2.72m^2 / 29.2ft^2	3m^2 / 31.8ft^2	3.28m^2 / 35.3ft^2	4.4m^2 / 47.3ft^2
Gross Dry Weight (Standard SS Frame)	35kg / 76.5lb	57kg / 152.4lb	63.4kg / 139.5lb	71.3kg / 157lb	95kg / 208.5lb
Fluid Capacity	310ml / 10.5floz	502ml / 17 fl oz	550ml / 18.6 fl oz	600ml / 20.3 fl oz	790ml / 26.7 fl oz
Max Operating Pressure [4]	8bar / 800kPa				
Tilt Range	20-80°				
Max Snow Load	300kg/m^2 / 60lbs/ft^2				
Max Wind Speed [5]	208km/h / 130mph				

1. Length of frame front track;
2. Width of manifold (not including inlet/outlet ports);
3. Aperture = Inner diameter of outer glass tube x exposed tube length
4. Pressure relief valve may be rated at 850kPa.
5. Refer to installation guidelines for collector mounting frame and consult mechanical engineer and local regulations before completing an installation in high wind area.

1.5. Naming Convention

Refer to the Apricus product catalogue for complete details of all product and names. Below are explanation of the manifold, collector and frame kit naming which are covered in this manual.

1.5.1. Manifold & Collector Naming

Naming Format: APSE - AAAA - BB - CCC

AAAA COMP = complete collector including manifold, standard frame and evacuated tubes

KIT = manifold and standard frame (no evacuated tubes)

BB Material of the frame: SS = Stainless Steel, AL = Aluminium

CCC Number of evacuated tubes: 10T, 18T, 20T, 22T or 30T

e.g. APSE-COMP-SS-30T = Complete 30 tube collector with stainless steel standard frame.

APSE-KIT-AL-20T = 20 tube manifold and aluminium standard frame

APSE-30T = 30 tube manifold only

1.5.2. Mounting Frame Kit Naming

Naming Format: APFR - AAA - BB - CCC - DDD - EEE

AAA KIT = Indicates an angle frame assembly. No KIT indicates a single component or sub-assembly.

BB Material of the frame: SS = Stainless Steel, AL = Aluminium

CCC Frame Style: STD = Standard, UF = U Foot, RR = Roof Rail, RF = Round Foot, RT = Roof Track

DDD Angle of the frame: 10D, 30D, 45D or 30<60D (adjustable angle)

EEE Number of evacuated tubes: 10T, 18T, 20T, 22T or 30T

e.g. APFR-KIT-SS-UF-30D-20T = 20 tube stainless steel 30° angle frame with U feet attachment

APFR-KIT-AL-RR-45D-30T = 30 tube aluminium 45° angle frame with roof rail attachment

Refer to section 4 for more information on frames and mounting.

2. Transport, Unpacking and Inspection

2.1. Safe Transportation

Evacuated tube and manifold boxes should be handled with care when transporting to avoid breakage.

a) If standing boxes on end, adhere to the direction arrows.

b) If lying boxes down, ensure the surface is flat.

c) Adhere to the markings on the number of boxes that may be stacked.

d) Do not stack any heavy or sharp objects on top of the boxes.

e) Always secure boxes in place to avoid bouncing or sliding around during transport.

2.2. Component Lists

a) Review the components lists included in the component boxes. If any components are missing, or additional parts are required, contact the local supplier.

2.3. Tube & Heat Pipe Unpacking & Inspection

a) Open the tube box(es), which contain the evacuated tubes with heat pipes inserted. Check to make sure the evacuated tubes are all intact, and the bottom of each tube is still silver coloured. If a tube has a white or clear bottom, it is damaged and should be replaced. The heat pipe should be removed from the damaged tube and inserted into a replacement tube. Replacement tubes are available from your local Apricus dealer who supplied the solar collector.

e) Heat pipes are bright and shiny when newly manufactured, but will dull and may form dark-grey surface discoloration over time. This is due to mild surface oxidation (when exposed to air) and is normal and does not affect the integrity of the heat pipe.

d) Do not remove and/or expose the tubes to sunlight until ready to install, otherwise the heat pipe tip will become very hot, and may cause serious skin burns. The outer glass surface will not become hot.

e) Apricus does not warrant the tube or heat pipes against failure as a result of damage incurred during transport or installation.

> ⚠ WARNING
>
> - NEVER TOUCH THE INSIDE OF THE EVACUATED TUBE OR HEAT PIPE TIP AFTER EXPOSURE TO SUNLIGHT.
> - WEAR THICK LEATHER GLOVES IF HANDLING A HOT HEAT PIPE.
> - WEAR SAFETY GLASSES AT ALL TIMES WHEN HANDLING THE GLASS TUBES

2.4. Frame Unpacking & Inspection

a) Unpack the standard frame that is provided together with the manifold. If an angled frame kit is being used, those components will be packed separately from the manifold. See section 4 for standard frame diagram.

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.

3. System Design

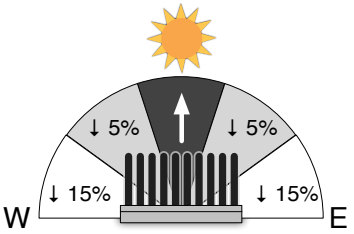
3.1. System Design

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 authorized 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 unauthorized persons.

3.2. Collector Direction

a) The collector should face the equator, which if in the northern hemisphere is due South, and southern hemisphere is due North.

b) The collector will still work even facing at angles East or West of the equator direction but a reduction in output will result (depending on location and system configuration). The diagram to the right provides a rough guide.

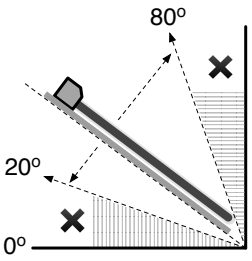


3.3. Installation Angle

a) For optimal annual solar output, install the collector at an angle equal to the location's latitude. An angle of +/- 10° 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° greater than the latitude of the location which will help reduce summer output and maximise winter output.
E.g. Latitude of 30°, install at 45-50°.

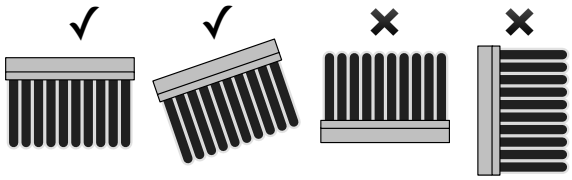
c) The collector must be installed within the range of 20-80° to ensure optimal operation of the heat pipes.



3.4. Collector Plane

a) The collector manifold is normally installed on the flat horizontal plane, but may be installed at an angle such as when installed sideways on a pitched roof.

b) The collector must not be installed up-side-down (tubes pointing upwards) or with tubes lying horizontally, as the heat pipes will not function.



3.5. 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.

3.6. 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.

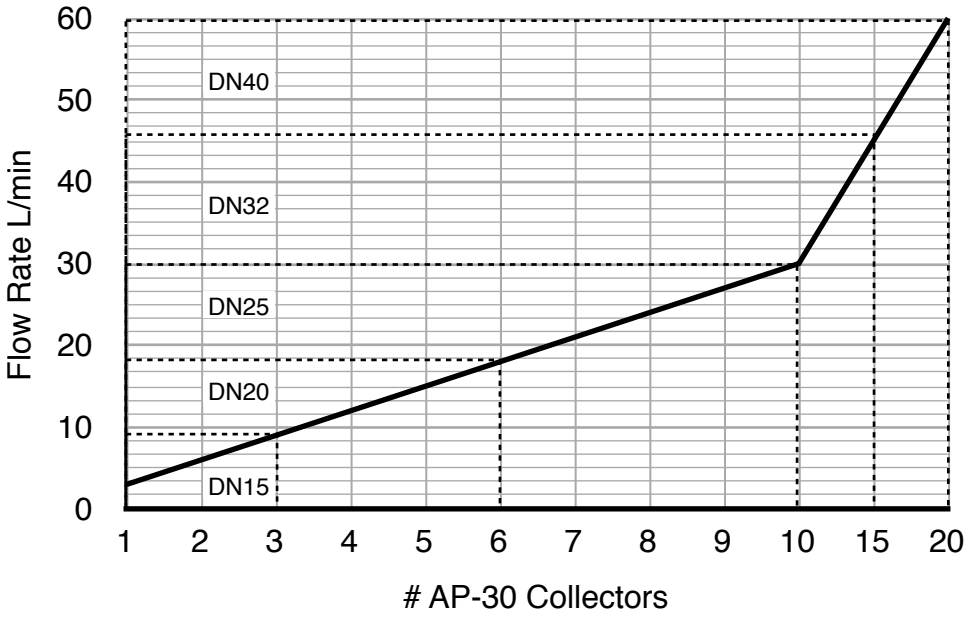
3.7. Pipe Connections

a) Depending on your location the AP solar collector may be provided with one of the following port configurations:

- 22mm OD copper pipe, compatible with standard olive compression or o-ring fittings.
- Flared copper pipe with union-nut and brass connector provide a ¾" M BSP thread.

3.8. Pipe Size and Flow Rates

a) As a general rule piping should be chosen to achieve a maximum flow speed of 1m/s / 3.3ft/s. The diagram below shows recommended pipe diameter (DN nominal pipe size) and maximum flow rate per collector.



b) Maximum total flow-rate through any collector is 15L/min / 4gpm (~1m/s)

c) The pipe, pump, valve and fittings on the solar line must be rated to at least 110°C / 230°F, and if within 2m / 6ft of the collector, rated for high temperatures of >200°C / 392°F.

d) A maximum of 3 x AP solar collectors may be connected in series with a straight (non-flexible) connector. For more than 3 collectors in series a flexible connection must be used every 3 collectors.

e) As many as 10 x AP-30 solar collectors may be connected in series as long as flexible connectors are used and maximum flowrate limit is adhered to, as outlined above.

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

3.9. 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 gradually 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.

d) In regions where freeze protection is required, it is advisable to use a closed loop system with a non-toxic grade polypropylene glycol used as the heat transfer liquid. 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. Please refer to the guidelines provided by the glycol manufacturer regarding replacement times.

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.

3.10. Solar Controller Settings

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 slightly according to the location and system design. Refer to the controller installation manual for more information.

3.11. 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 this will provide 60-80% annual contribution to domestic hot water.

3.12. Stagnation and Overheating

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

b) If the system is designed to allow stagnation as a means of preventing tank overheating, the collector and plumbing in close proximity may reach temperatures of >200°C / 395°F; therefore components that may be exposed to the high temperatures such as valves, plumbing or insulation, should be suitably rated.

c) For direct flow systems, if the system is allowed to stagnate, steam may form in the header (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.

The pressure and temperature relief valve on the tank may open to release pressure or heat as required. Under such conditions the collector manifold will normally reach a maximum temperature of approximately 160°C / 320°F.

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.

3.13. 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 must be able to 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). Please see section 3.4 regarding insulation of piping for high temperatures, and section 2.2.3 regarding 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 or steam back system operation allows the manifold to clear of heat trasnfer liquid during stagnation.

d) Any system design must provide means for allowing pressure release at no more than 850kPa, 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.

3.14. 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 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 propylene 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.

c) Evacuated tubes are not susceptible to damage in cold weather, and Apricus heat pipes are protected against damage that could result from the freezing of the water inside.

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

3.15. 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° 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.

3.16. Snow Load

a) In areas prone to heavy snow falls the solar collectors should ideally be installed at an angle of 50° or greater to help promote snow sliding off the tubes. In addition it is advisable to raise the front of the collector frame 15-20cm off the roof surface as this allows snow to sit beneath the collector and also more easily blow away from under the collector. See the picture to the right.

A front track extension (#FR-SS-FTEXT) can be used for this purpose.

b) The solar collectors are able to withstand a maximum snow loading of 300kg/m^2 / 60lbs/ft^2. Refer to local regulations regarding snow loading guidelines.

3.17. Hail Resistance

a) Apricus glass evacuated tubes are able to withstand impact from hail up to 25mm /1" in diameter.

b) In areas prone to large hail (>⌀20mm / ⌀3/4") it is recommended to install at an angle of 40° or greater to provide optimum protection.

c) The solar collector can still function properly with one or more broken tubes, however a reduction in heat output will result (depending upon how many tubes are broken). A broken tube should be replaced by authorised persons only. Please refer to section 8.3 for more details on tube replacement.

3.18. Lightning

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 solar collectors are supplied with a standard frame, which is suitable for flush mounting on a suitably pitched roof. For installation on low-pitched roofs, flat roofs or on walls, additional angle frame kits are available.

> ⚠ 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.

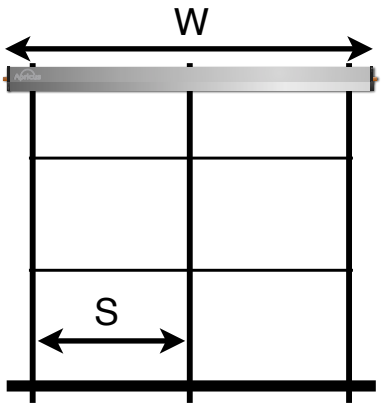
4.1. Frame Material

Apricus offers two types of frame materials as follows:

- Stainless Steel: Suitable for most applications
- Anodised Aluminium: Stronger and more corrosion resistant than stainless steel, these frames are suitable for high wind regions or environments that stainless steel is susceptible to “tea staining” discolouration (surface corrosion).

4.2. Frame Track & Leg Spacing

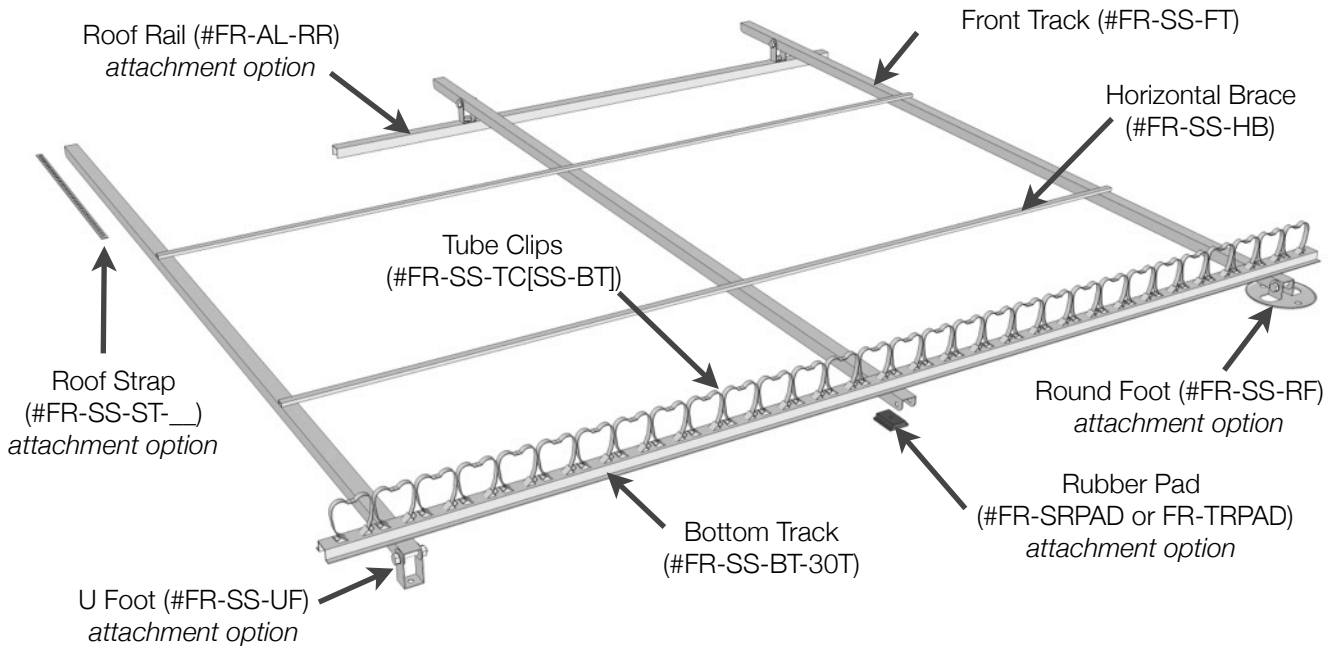
Collector	S	W
10 tubes	490mm	796mm
18 tubes	1050mm	1356mm
20 tubes	1190mm	1496mm
22 tubes	665mm	1636mm
30 tubes	945mm	2196mm



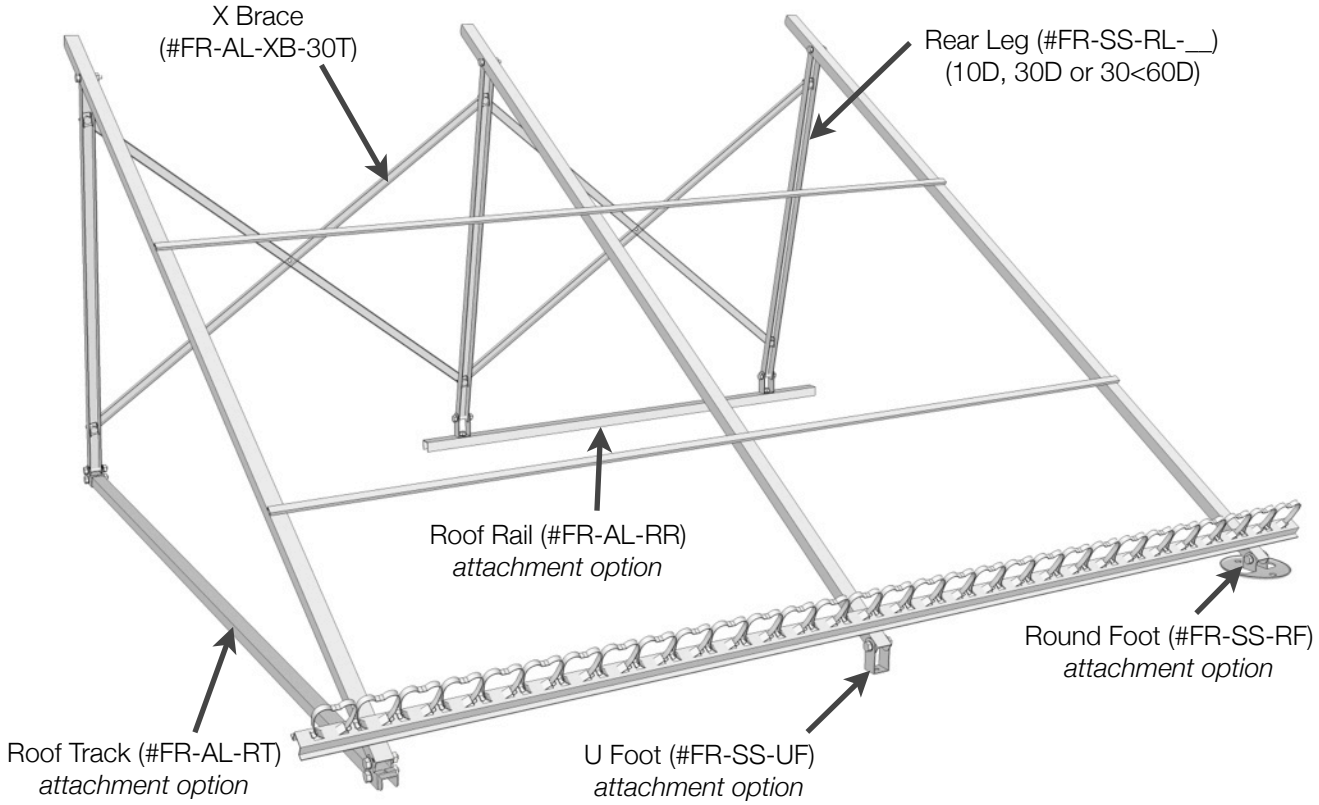
4.3. Frame Component Diagrams

The Standard Frame comes standard with the manifold kit. Angled frame kits can also be ordered to raise the angle of frame and there are various options for roof attachment. The following pages provide diagrams of frames kits and optional roof attachment components.

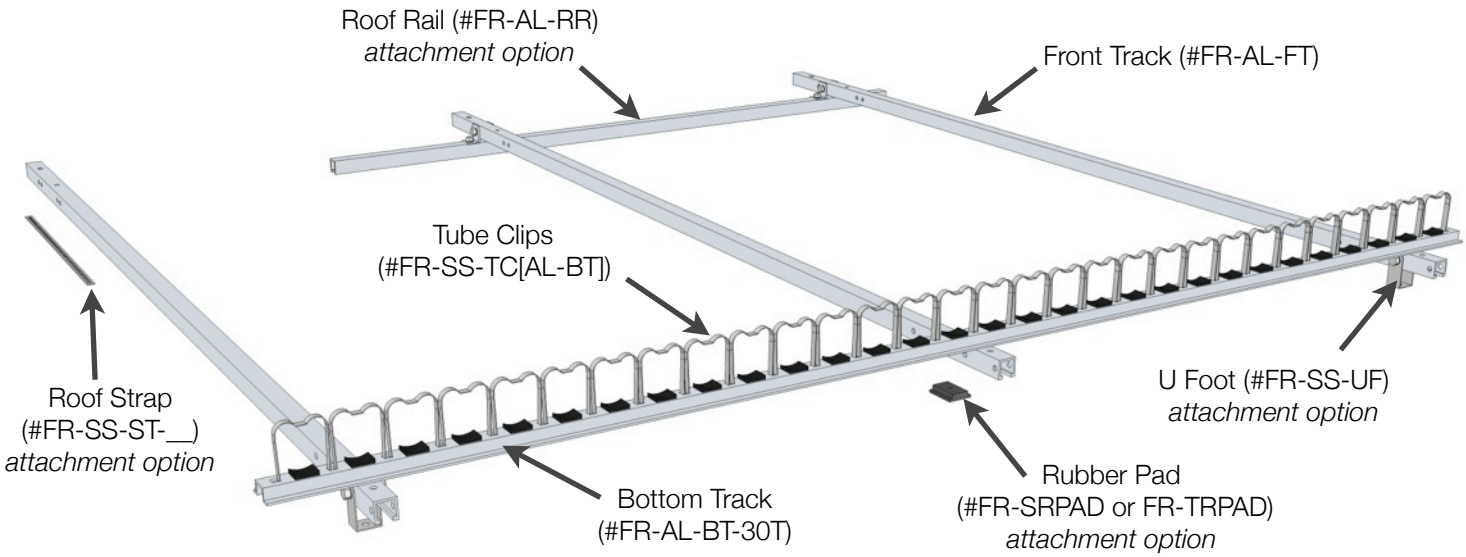
SS Standard Frame (30 tube)



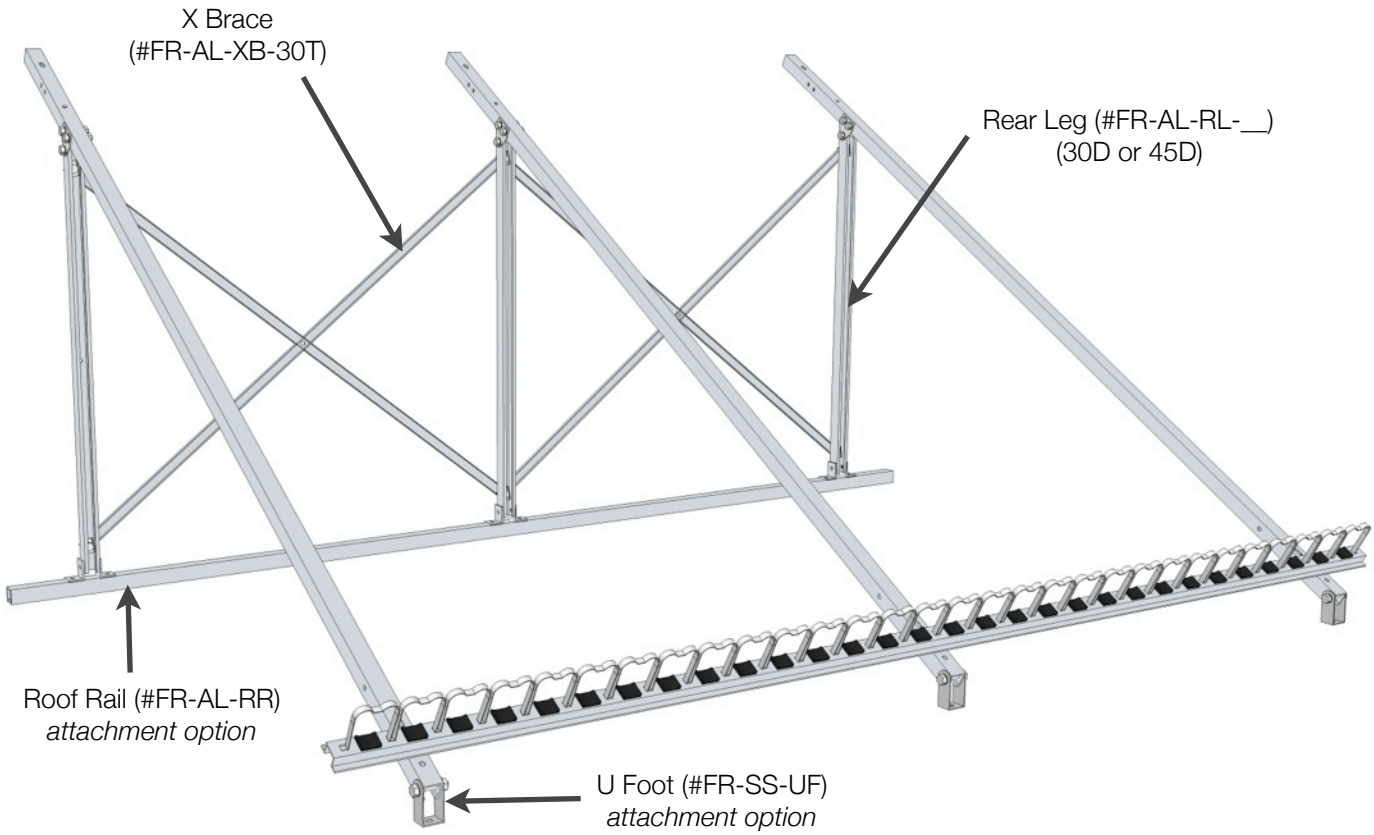
SS Angle Frame (30 tube)



AL Standard Frame (30 tube)

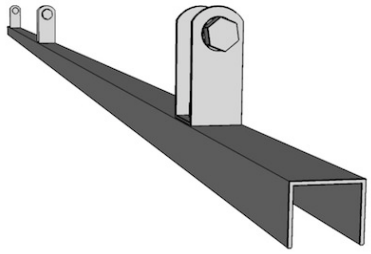


AL Angle Frame (30 tube)

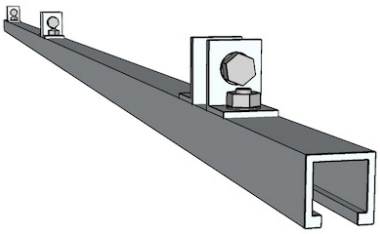


Frame Attachment Components

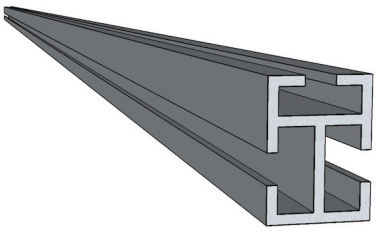
Name: SS Roof Rail
Part #: FR-SS-RR-XX (XX = 10, 18, 20, 22 or 30T)
Notes: Stainless steel horizontal roof rail complete with U Feet for use with stainless steel standard frame or angled frame kits. Ideal when roof attachment points do not align with standard frame spacing.



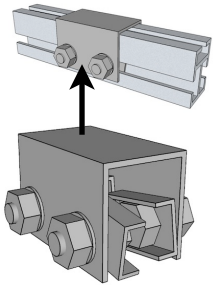
Name: AL Roof Rail
Part #: FR-AL-RR-XX (XX = 10, 18, 20, 22 or 30T)
Notes: Aluminium horizontal roof rail complete with L Brackets for use with aluminium standard frame or angled frame kits. Ideal when roof attachment points do not align with standard frame spacing.



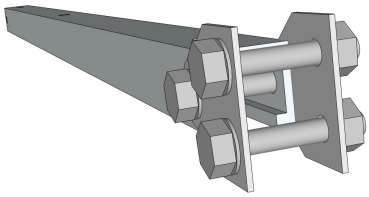
Name: XL Roof Rail
Part #: FR-AL-XLRR
Notes: Aluminium heavy duty horizontal roof rail with both top and side slide channels for U foot (FR-SS-UF) attachment. Ideal for commercial projects where multiple collector are installed in series.



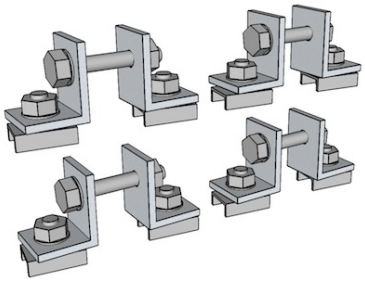
Name: XL Roof Rail Connector
Part #: FR-SS-XLRR-CON
Notes: Connects XL Roof Rails end to end. Comes with 4 x FR-BOLT-M8x20-SPW-NL fasteners.
Use FR-SS-XLRRCON to connect rails end to end.



Name: AL Rear Leg (30 or 45º)
Part #: FR-AL-RL-XX (XX = 30D or 45D)
Notes: Rear leg for aluminium angled frame kits, supplied with attachment plate and fasteners. Additional Rear Legs can be added to increase frame strength for high wind regions.



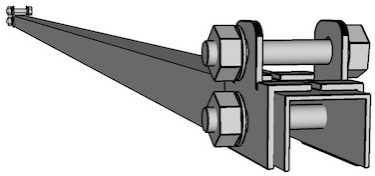
Name: L Brackets (set of 4 pairs)
Part #: FR-AL-LB-x4
Notes: Set of 4 pairs of L Brackets for use when adding Front Tracks or Rear Legs to frame kits for high wind regions. 4 pairs suitable for 30T frame allow increase from 3 to 5 Tracks/Legs



Name: Roof Track

Part #: FR-SS-FT

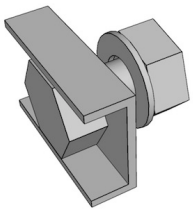
Notes: Provides the same flush mounting method as the front track for stainless steel angled frames.



Name: M8x20 Nut Lock Assembly

Part #: FR-BOLT-M8x20-SPW-NL

Notes: Assembly including M8x20 Bolt, M8 Nut, Spring Washer & Nut Lock. Used for attachment of various components

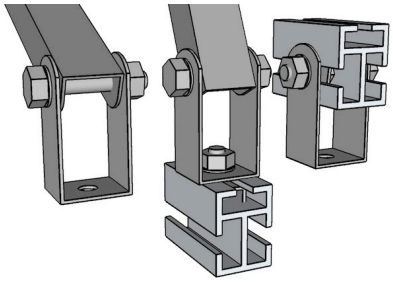


Name: U Foot (with 3 fastener options)

Part #: a) FR-SS-UF[M8x50]
b) FR-SS-UF[M8x50&M8x20]
c) FR-SS-UF[2xM8x20]

Notes: Can be used in many attachment formats as shown in the diagram. Compatible with with SS or AL frames. Diagram shows examples of how the 3 U Foot options are used. All fasteners shown are included. Rails and tracks are not included.

a b c

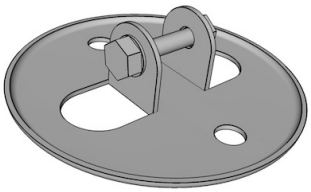


Name: Round Foot

Part #: FR-SS-RF[M8x50]

Notes:

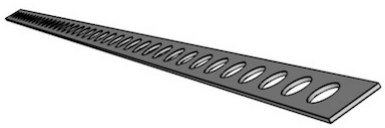
- Large surface area with two holes for roof attachment.
- Requires matching spacing of roof attachment points.
- Comes with M8x50 Bolt for attachment to frame Tracks or Rails.



Name: Roof Strap

Part #: FR-SS-RS-XX (XX = 60 or 100 indicating the length in cm)

Notes: Suitable for used on flush mounting of standard frame on tiled roofs. Not suitable for high wind regions.

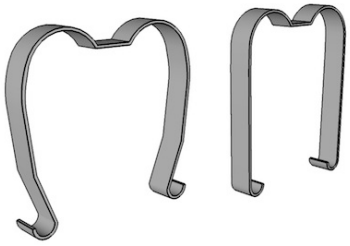


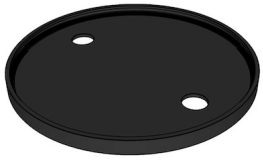
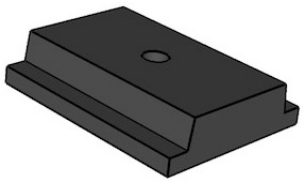
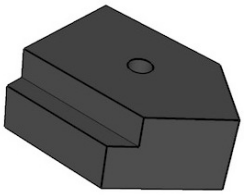
Name: Tube Clips

Part #: a) FR-SS-TC[SS-BT] b) FR-SS-TC[AL-BT]

Notes: Clip that holds Tubes in place. Supplied with Standard Frames.

a b



Name: Round Foot Cover **Part #:** FR-RFC **Notes:** Used under Round Foot to protect roof from direct metal contact. 	**Name:** Standard Rubber Pad **Part #:** FR-SRPAD **Notes:** Provides the same flush mounting method as the front track for stainless steel angled frames. 
Name: Standard Rubber Pad **Part #:** FR-SRPAD **Notes:** Provides the same flush mounting method as the front track for stainless steel angled frames. 	**Name:** Tube Rubber Cap **Part #:** FR-TRCAP **Notes:** Protective rubber cap on end of ETs. Supplied standard with all boxes of Evacuated Tubes. 

The table below provides the standard components quantities for each style of frame kit.

Kit Name (Code)	Component (product code)	AP-10	AP-18	AP-20	AP-22	AP-30
SS Standard Frame (#APFR-KIT-SS-STD-__T)*	Front Track (#FR-SS-FT)	2	2	2	3	3
	Bottom Track (#FR-SS-BT-__T)	1	1	1	1	1
	Horizontal Brace (#FR-SS-HB-__T)	2	2	2	2	2
	Tube Clips (#FR-SS-TC[SS-BT]	10	18	20	22	30
AL Standard Frame (#APFR-KIT-AL-STD-__T)	Front Track (#FR-AL-FT)	2	2**	2**	3	3**
	Bottom Track (#FR-AL-BT-__T)	1	1	1	1	1
	Tube Clips (#FR-SS-TC[AL-BT]	10	18	20	22	30
SS 10º Angle Frame Kit (#APFR-KIT-SS-__-10D-__T)	10º Rear Leg (#FR-SS-RL-10D)	2	2	2	3	3
	10º X Brace (#FR-SS-XB-10D-__T)	1	1	1	1	1
SS 30º Angle Frame Kit (#APFR-KIT-SS-__-30D-__T)	30º Rear Leg (#FR-SS-RL-30D)	2	2	2	3	3
	X Brace (#FR-SS-XB-__T)	1	1	1	1	1
SS 30-60º Adj Angle Frame Kit (#APFR-KIT-SS-__-30<60D-__T)	30-60º Rear Legs (#FR-SS-RL-30<60D)	2	2	2	3	3
	X Brace (#FR-SS-XB-__T)	1	1	1	1	1
AL 30º Angle Frame Kit (#APFR-KIT-AL-__-30D-__T)	30º Rear Leg (#FR-AL-RL-30D)	2	2**	2**	3**	3**
	X Brace (FR-AL-XB-__T)	1	1	1	1	1
AL 45º Angle Frame Kit (#APFR-KIT-AL-__-45D-__T)	45º Rear Leg (#FR-AL-RL-45D)	2	2**	2**	3**	3**
	X Brace (FR-AL-XB-__T)	1	1	1	1	1

* __ indicates there are multiple components choices, __T indicated choice of 10, 18, 20, 22 or 30 tubes.
Refer to section 1.5 for explanation of naming convention.
** For high wind load regions the use of the AL frame is recommended and additional front tracks and rear legs may be added to increase the frame strength. AP-18 increase to 3 front tracks and rear legs, AP-20, AP-22 and AP-30 increase to 5 front tracks and rear legs.

4.4. Galvanic Reaction

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

b) If the roof surface is galvanized steel, rubber pads (#FR-SRPAD) can be used to separate the stainless steel frame from the metal roofing material.

c) 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.

4.5. Installation Planning

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

b) Any attachment points must be structurally sound and suitable thickness bolts or screws used, normally 7mm, 5/16" are suitable. Refer to local building codes for suitable requirements.

c) 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. Apricus also offers silicone rubber frame pads which can be used for some roofing materials, providing a good roof seal when combined with quality roof sealants.

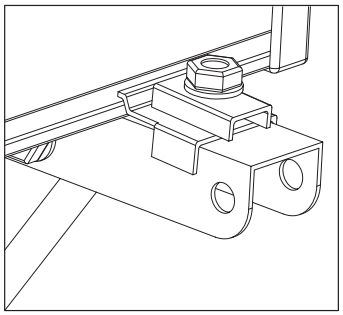
4.6. Frame Assembly Process

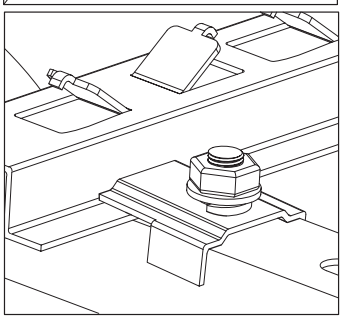
a) Where possible, assemble the mounting frame and attach the manifold at ground level, then carry to the roof. NEVER install the evacuated tubes at ground level, as these should be installed after the system is commissioned with liquid flowing through the manifold.

b) Only gently tighten nuts until attachment to the roof is complete, then hand-tighten all bolts with the provided spanner/wrench or suitably sized socket. NEVER use power tools as the stainless steel fasteners may gall/lock up. 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.

4.7. Manifold and Bottom Track Attachment





a) Both the manifold and frame bottom track are secured to the frame front tracks using special attachment plates. These plates are already attached to the front tracks when shipped, so they only have to be loosened to allow the manifold and bottom track to be fitted.

b) The attachment plates are designed such that when loose, the manifold and bottom track are able to slide left and right. This allows the front tracks to be easily adjusted to suit the roof surface attachment points.

c) The horizontal brace component (#FR-HB) provided with the standard frame (stainless steel only) does NOT provide a structural role and simply to help aline the front tracks when the frame is assembled, particularly for angled frame assembly. The brace may be removed if the location of the front tracks are altered, or new ⌀9mm / 0.35" holes may be drilled.

d) Front tracks should be located under the 2nd, 3rd or 4th tube from each end to ensure optimal strength under wind or snow loading. The middle leg (where applicable) should installed no more than 2 tubes left or right of the centre.

e) Once components are correctly located the nuts should be tightened using the supplied spanner/wrench, locking the manifold and bottom track in place.

f) The U channel on top of the manifold attachment plate provides additional strength to the attachment. The U channel MUST be orientated parallel to the front track as shown in the diagram to the right.

4.8. Angled Frame Kits

a) Angled frame kits combine with the standard frame to provide a complete assembly. Different angle options are available for stainless steel and aluminium frames as outlined below:

- Stainless steel frame options: 10°, 30° and 30-60° adjustable.
- Aluminium frame options: 30° and 45°.

b) Choose a mounting angle that is closest to the desired angle. Collector efficiency is not greatly effected by an

angle that is +/- 10º the desired installation angle.

4.9. Roof Attachment Strength

a) Frame attachment to the roof should be completed with ⌀8mm / 5/16" or larger stainless steel bolts.

b) Ensure the mounting surface or ballast is solid and able to withstand in excess of 150kg / 330lbs of pull force that may be encountered during high winds. Refer to Apricus document [AP_Collector_Wind_Loading_Calculator.xls] for wind loading estimates.

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

4.10. Wall Mounting

a) The collector may be mounted on a wall with the bottom of the tubes angled away from the wall. The maximum collector installation angle for this format is 80o.

b) Ideally use a 30o angle frame kit with the rear legs attached to the bottom of the front tracks rather than the top. For aluminium frames additional holes can be drilled in the front track to accommodate the triangle shaped attachment plates.

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.

f) If installing on a wall so the collector is above a walkway, please consider the danger associated with broken glass that could fall if the tubes were ever damaged. It may be necessary for a barrier of to be installed below the collector to catch any such falling materials.

4.11. Custom Frame Support Structure

a) If a custom frame is built to support the solar collector standard frame, attachment to the front track must be in the support ranges. This ensures that load points are close to support points, preventing excessive overhang that could lead to front track bending during snow or wind loading.

b) The support range is 250mm measured from the ends of the front tracks.

5. Piping Connection

5.1. Collector Connection to Plumbing

a) Once the frame has been mounted and the manifold attached, the manifold header may be connected to the system plumbing. The plumbing connection must be completed before evacuated tubes are installed.

a) Two header configuration are produced by Apricus, but only one will be available in your market:

- 22mm OD copper header pipe: Use 22mm copper olive compression fittings (#BF-ST-CO22x3/4"MBSP) or soldered connection.
- Flared Nut: If the collector is provided with a loose nut on the header pipes, use Apricus standard brass adapters. These adapters will provide a ¾" M BSP thread (#BF-ST-FL19x3/4"MBSP).

c) Brazing/Sweating/Soldering to the header is acceptable, but care must be taken to avoid exposing the manifold casing to the torch flame. Use a wet cotton cloth around the base of the header pipe to reduce the temperature of the copper pipe in contact with the silicone rubber seal.

5.2. Temperature Sensors

a) Ensure that sensors used on the collector are high temperature rated (up to 200°C / 395°F), including the cable.

b) The temperature sensor port is located beside the header ports. Always insert the sensor port in the outlet port. 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 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, provided in the manifold box.

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.

5.3. Pipe Insulation

a) Heavily insulate all piping running to and from the manifold with a high quality insulation of at least 15mm/0.6" 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 manifold casing with silicone sealant or foil tape to prevent water ingress.

d) For systems designed to allow stagnation, high temperature rated insulation such as glass wool or mineral wool should be used on piping close to the collector (~2m / 6'). Glass wool insulation may come with an external foil wrap, but any cuts made during installation should be sealed with watertight and UV stabilized material such as adhesive backed aluminium foil.

5.4. 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 (Open Loop):

- 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 (Open Loop):

- Run the pump at the highest speed settings, forcing air out of the manifold 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.

d) Closed Loop:

- The solar loop should be filled with glycol/water mix (or suitable heat transfer fluid), vented and pressurized. 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.

5.5. Pump Selection

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

- Flow-rate: The nominal summer flow-rate per AP-30 collectors is (0.1L/tube / 0.026G/tube each minute) to achieve ~7^{o}C temperature rise during normal operating conditions.
- 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 and G=1000W/m^2). Values of up to ~15-20% higher are possible in the 2 hours either side of midday due to the IAM factor.

Flowrate (L/min)	**Temp Rise (^{o}C)**				
	AP-10 (648W)	**AP-18** (1166W)	**AP-20** (1296W)	**AP-22** (1425W)	**AP-30** (1944 W)
1	9.3	16.7	18.6	20.4	27.9
2	4.6	8.4	9.3	10.2	13.9
3	3.1	5.6	6.2	6.8	9.3
4	2.3	4.2	4.6	5.1	7.0
5	1.9	3.3	3.7	4.1	5.6

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 air lock in the collector or flow and return lines; repeat air-purge process.
- Check operation of the non-return valve.
- Pump operation. Pump may not be bled of air, or there may be cavitation (air bubbles forming) due to installation issues.
- Pump may not have sufficient head pressure.

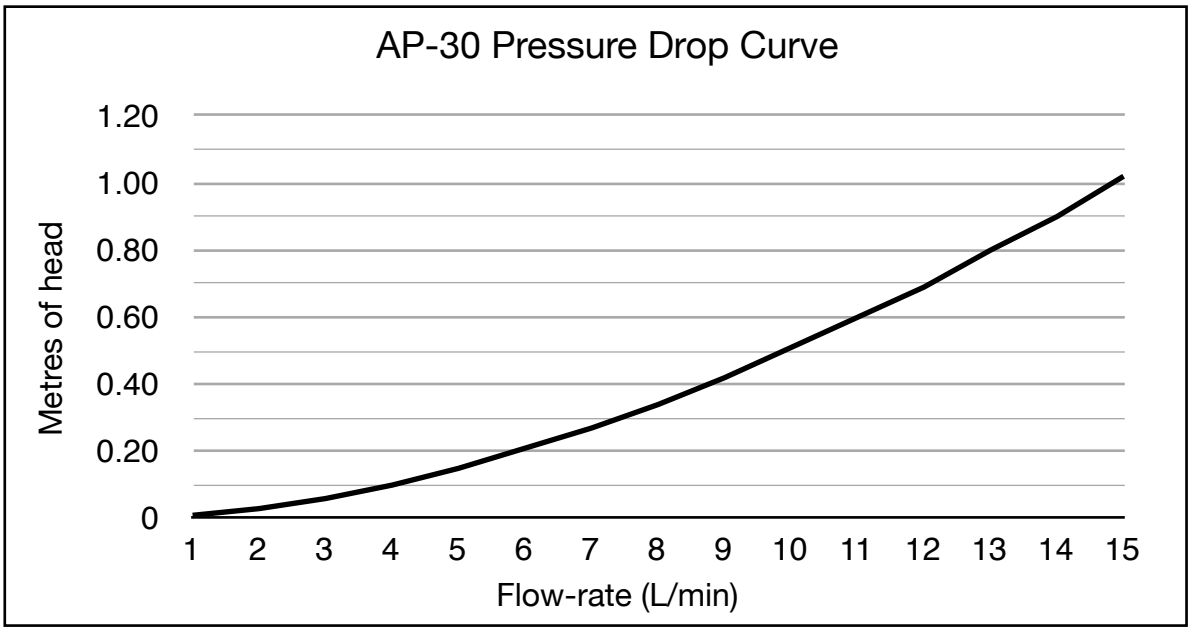
e) Always use hot water rated pumps (up to 110^{o}C / 232^{o}F)

f) Always install the pump on the flow 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.

5.6. Pressure Drop

a) Pressure drop through an Apricus 30 tube header with cold water at 3L/min is approximately 1kPa.

b) See graph below for pressure drops at flow rates up to 15L/min.



6. Evacuated Tube Installation

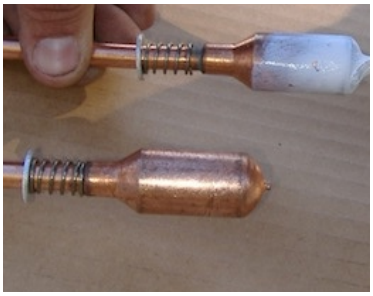
⚠ WARNING
DO NOT INSTALL THE HEAT PIPES AND EVACUATED TUBES UNTIL SYSTEM PLUMBING IS COMPLETED AND PUMP AND CONTROLLER ARE OPERATIONAL ALWAYS WEAR SAFETY GLASSES WHEN HANDLING EVACUATED TUBES

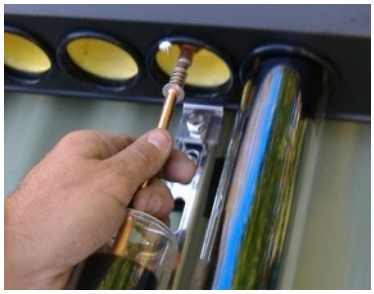
6.1. Tube & Heat Pipe Preparation

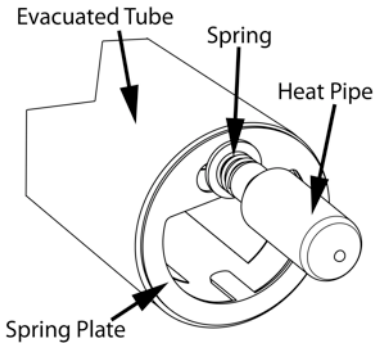
a) Cut open the top end of the evacuated tube box to expose the heat pipe tips.

b) While holding the top spring plate in place, pull out all the heat pipes by ~15-20cm.

c) Coat all the heat heat pipe tips with a thin layer of heat transfer paste. The easiest and cleanest way to coat the tips is to use a 10-15cm length of rubber insulation pipe with ID of ~22mm. Squirt some heat transfer paste into the pipe and then insert each heat pipe. Ensure the coated paste is not exposed to any dirt or other contaminates.







d) Tube tubes are fragile so take care when handling as any knocks could break the tube.

e) Do not expose tubes to sunlight until ready to install, otherwise the heat pipes will become extremely hot, and could cause serious burns if touched. Wear thick protective gloves if handling hot tubes & heat pipes.

g) IMPORTANT INFORMATION: Heat pipes contain a small amount of copper powder which aids in heat transfer and provides protection against freeze related damage to the heat pipe. To ensure that the powder is at the bottom of the heat pipes where is needs to be, all boxes of tubes, or individual tubes need to be turned up-side-down, and then returned to the upright orientation. In addition, before installing the tube and heat pipe, they should be shaken up and down a couple of times (heat pipe at top) to ensure the powder has all returned to the bottom.

6.2. Tube & Heat Pipe Insertion

a) The heat pipe should still be pulled out of the ET by ~15-20cm to allow the heat pipe to be properly inserted.

b) If an evacuated tube is damaged for any reason (e.g. knocked heavily or dropped), it will need to be replaced. Either use another tube with heat pipe already inserted, or if a plain evacuated tube spare is being used, carefully remove the heat pipe from the broken tube and insert into the new tube.

Insert the new heat pipe carefully, holding the heat pipe close to the tube opening and inserting by making a short push and twisting action. Never throw heat pipes away, as they are very sturdy and will generally not be damaged even if the tube is broken. Heat pipes can be kept as spares, or inserted into plain spare evacuated tubes.

c) Lubricate the top outer surface of the evacuated tube with a small amount of water. This facilitates easy insertion past the manifold rubber ring seal. A small pump spray bottle is the best method for carrying and applying the water.

d) **IMPORTANT INFORMATION:** Do not spray water into the evacuated tube.

e) Follow this process to insert the evacuated tube into the header:

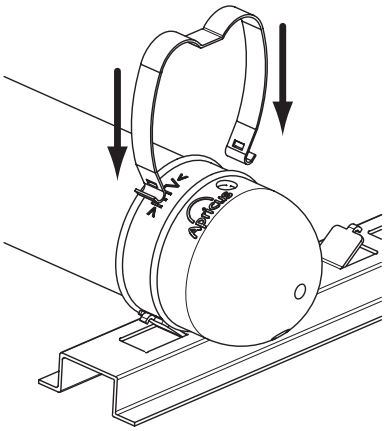
STEP 1: Firmly hold the evacuated tube, taking care to ensure the metal spring plate is sitting in the mouth of the evacuated tube

STEP 2: With the heat pipe positioned at the top of the evacuated tube, guide the heat pipe tip in past the manifold rubber seal and into the heat pipe port. Push in full depth.

STEP 3: Using a 1/8th left and right twisting action, push the evacuated tube up into the manifold. The neck of the evacuated tube will push against the spring at the base of the heat pipe tip, forcing it fully into the port.

f) The heat pipe and evacuated tube are fully inserted once the black coating of the evacuated tube has disappeared up into the manifold (no clear glass visible) and the bottom of the tube sits correctly in the bottom track.

g) As each tube is inserted, or alternatively once all tubes have been inserted, secure the tubes to the bottom track using the stainless steel clips as follows:



STEP 1: Line up the clip with the hook on the bottom track and push down on one side until a “click” sound is heard.

STEP 2: While ensuring the clip is centered of the rubber cap, push down the other side of the clip until it too “clicks” into position.

STEP 3: Check to ensure both sides are correctly clipped over the hooks.

h) The clip can be removed by using a small screwdriver or needle nosed pliers to pull each side of the clip down and outward.

i) As the distance between consecutive tubes is minimal, it may be necessary to push a consecutive tube slightly off to the side while attaching the clip to allow enough room to operate.

6.3. Post Installation Cleaning

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

7. Post Installation Check

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

The following checklist is provides as a guide. It is recommended to develop a more comprehensive that is appropriate for the local system design and installation method.

1	Collector faces correct direction (equator pointing) and is suitable installation angle of 20° – 80°	Y	N
2	Collector is not shaded through the day, especially between 9-3pm	Y	N
3	No overhanding trees or objects likely to fall on the collector	Y	N
4	In areas prone to large hail (>∅20mm / ∅3/4"), collector is installed at an angle of 40° or greater.	Y	N
5	Frame is secured to structurally sound roof/wall.	Y	N
6	Plumbing is leak free.	Y	N
7	Plumbing pipe runs are well insulated right to the manifold casing.	Y	N
8	Sensor cable is not in contact with any metal objects, is secured in place and protected from direct. sunlight.	Y	N
9	Insulation above roof level is protected against sunlight with aluminium foil wrap or equivalent.	Y	N
10	Controller is configured correctly with freeze setting on (if required).	Y	N
11	System is fitted with pressure relief valve on the pump station (closed) or tank (direct).	Y	N
12	Pressure relief valve will dump only onto high temperature resistant material and will not pose a danger of scolding people.	Y	N
13	Pump, controller and all electrical connections are protected from water ingress.	Y	N
14	Evacuated tubes have been cleaned.	Y	N
15	Installation record form has been given to customer and basic operation explained.	Y	N
16	Functional checks for controller and pump have been completed.	Y	N
17	Water quality has been checked (if applicable).	Y	N

8. 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

8.1. Cleaning

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

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

8.2. 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

8.3. Broken Tube Replacement

a) If a tube is broken it should be replaced as soon as possible to maintain maximum collector performance.

b) The system will still operate normally and safely even with a tube broken.

c) Any broken glass should be cleared away to prevent injury.

d) To replace a tube, follow these guidelines:

- Remove the tube clip(s), slide broken tube out and carefully pick up any glass pieces. Protective gloves must be worn when handling broken glass, and avoid touching the glass wool insulation with bare hands, as it can cause mild skin irritation.
- When removing the broken tube, the rubber ring in the manifold casing may pop out. Just return this ring into place before inserting the new tube.
- If the heat pipe is not easily removed (commonly the case), it can be left in place and a new evacuated tube inserted, guiding the heat pipe down the groove between the evacuated tube inner wall and heat transfer fin.
- If the heat pipe is easily removed, the easiest option is to replace the heat pipe and evacuated completely.

8.4. 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.

8.5. Draining the Collector

a) Draining of the manifold 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 manifold 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.

8.6. 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.

9. Troubleshooting

Those inspection items with an (H) may be completed by the home-owner, but only if such investigation is clearly both SAFE and the home-owner has sufficient technical understanding. 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
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
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 tubes	• Clean tubes. Refer to Maintenance section for safety instructions. **(H)**
	Damaged insulation	• Check that insulation is still in good condition with no exposed pipe. **(H)**
	Damaged evacuated tubes	• Check that evacuated tubes are all intact and the bottom is still silver
	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.

Problem	Cause	Solution
Poor Solar Heating Contribution (Compared to previous output at same time of year) continued...	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 dTMin 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 solar flow (tank to collector) port.
Tank cooling down at night. It is normal for tank to loose 0.3 - 0.4°C/ 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 form 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

10. 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.

11. Manufacturer's Limited Warranty

AP Solar Collector

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.

GENERAL

Apricus warrants its Solar Collectors and Accessories (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.

Component	Coverage
Manifold Casing	Ten years parts
Copper heat transfer header	Fifteen years parts
Evacuated Tubes and Heat Pipes	Ten years parts
Mounting Frame	Fifteen years parts

WARRANTY EXCLUSIONS

This warranty shall be void and shall have no effect if:

(a) 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;

(b) The Products are not installed or repaired in accordance with applicable local codes;

(c) The Products are not installed by qualified, suitably licensed persons;

(d) The installer had not received Product installation training by an authorized Apricus distribution partner:

(e) The installation was not completed in line with the guidelines of the then current Apricus installation manual;

(f) System is exposed to excessive system pressure;

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

(h) Any system component is damaged due to freezing;

(i) Any system component leaks due to corrosion;

(j) Water quality is not within specified limits, and/or non-approved heat transfer liquids are used;

(k) Damage to the collector header is caused due to heat buckling;

(l) Failure is due to wind, hail, storms or other acts of God;

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

(n) Product serial tag or other identification is defaced or removed;

(o) Product is relocated from its original point of installation;

(p) Collector is not commissioned and is left to dry stagnate for a period exceeding 14 consecutive days;

(q) 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 Products 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.

12. Installation Record Form

Thank you for choosing Apricus.

The following form should be completed by the Installation Officer and Home Owner to keep as a record of the installation in case of a warranty claim. Also please complete online registration 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 Installation Officer 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.