Apricus Solar Collector Installation and Operation Manual

International Edition

(Version 1.1 - Sep 06)

Contents

1. Important Information

1.1. Local Standards

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

1.2. Authorized Person(s)

a) Installation must be completed by a Certified Apricus Installer (installation officer).

b) Installation officer must also hold relevant industry licenses or certificates required for the work completed during the installation process.

c) The term "authorized person(s)" used throughout this document refers to a certified Apricus installer, in the case of non-Apricus equipment, a suitably qualified professional.

d) 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).

1.3. 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 (ie. 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 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 water expansion. The system design MUST NOT allow stagnation of the collector as a standard form of controlling tank temperature, as this will cause damage to the glycol.

d) Any system design must provide means for allowing pressure release at no more than 800kPa / 113psi.

e) It is recommend that the lever on pressure and temperature relief valves (PTRV) be operated once every 6 months to ensure reliable operation. It is important to **raise and lower the lever gently**, and be careful as the water released will be **HOT**.

f) It is recommended, and may also be a local regulation, that the pressure/temperature relief valve have a copper pipe connected, running the expelled hot water or air to a safe and appropriate drainage location.

1.4. Water Quality

a) Water in direct flow through the manifold header must firstly meet potable water requirements, and in addition the following:

Total dissolved solids	<	600 p.p.m.
Total hardness	<	200 p.p.m.
Chloride	<	250 p.p.m.
Free Chlorine	<	5 ppm
Magnesium	<	10 p.p.m.

b) In areas with "hard" water (>200ppm), lime scale may form inside the header pipe. In such regions, it is advisable to install a water softening device to ensure the long term efficient operation of the collector, or use a closed loop for the solar circulation loop.

c) If using a glycol/water mix, the water must meet the above requirements, and the glycol content of the liquid must not exceed 50%, unless the manufacture specifies that a different ratio is recommended for use with solar water heaters. Glycol must be changed periodically (every 3-5 years) to prevent the glycol from becoming acidic; please refer to the guidelines provided by the glycol manufacturer regarding replacement times.

d) In order to meet health and safety regulations, glycol used should be food grade.

1.5. Metallic Corrosion

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

b) Apricus does not warrant the solar collector against corrosion related damage.

1.6. 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 below –5°C / 23°F, simple low temp controller based freeze protection may be used. (ie. Pump circulates if the manifold temperature approaches freezing). If possible backup protection in the form of freeze valves (which open to allow water to dribble out) should also be installed.

b) For areas with temperatures below –5°C / 23°F, a closed loop filled with a glycol-water mix should be used to provide freeze protection. Please refer to glycol manufacturer's specifications about the temperature ranges the liquid can withstand.

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.*

1.7. Collector Gross Weights

AP-10 = 35kg / 77p AP-20 = 63.5kg / 139p AP-22 = 71.8kg / 157p AP-30 = 95.5kg / 210p

1.8. Wind Stress

a) When installing the collector, please consider the issue of wind resistance, and the resultant stress on attachment points. Please adhere to relevant building codes/regulations regarding installation of such objects.

b) The standard frame, and frames kits all designed to withstand wind speeds of up to 80mph / 128km/h without damage. For areas with wind speeds that may exceed this level an additional front track and rear legs (if applicable) should be installed.

c) If installing the low, mid, high or fixed angle roof frames, stainless steel cables may be used to further secure the frame, running from the top of the rear legs diagonally backwards.
See Appendices A through E for frame assembly details.

d) It is the responsibility of the installation officer to ensure that the frame mounting is of suitable strength. Where applicable inspection by builder department officers or equivalent should be completed to ensure the installation is in accordance with relevant regulations.

1.9. Hail Resistance

a) The glass evacuated tubes are surprisingly strong and able to handle significant impact stresses once installed. Testing and impact stress modelling proves that the tubes are able to withstand impact from hail up to 25mm /1" in diameter, and even larger when installed at angle of 40° or greater. The ability of the evacuated tubes to withstand impact from hail is greatly influenced by the angle of impact, and so installing the collectors at low angles does reduce their impact resistance.

b) It is recommended that in areas prone to large hail (>20mm / 3/4" diameter) the solar collector should be installed at an angle of 40° or greater to provide optimum protection. As many populated areas in the world fall within the latitude of ±30-70° this angle is generally a common installation anyway.

c) If in the unlikely circumstance that a tube should become broken it can be easily replaced. 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 authorized persons only.
Please refer to section 3.3 for more details on tube replacement.

1.10. Scope of Manual

a) This manual pertains only to the installation and operation of the Apricus solar collector. Details for the installation, operation and maintenance of the complete solar gas/electric water heating system including, but not limited to storage tank, gas/electric booster, pump, system controller, valves and other plumbing components should be provided separately by their respective manufacturers.

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.

2. Installation

2.1 Unpack and Inspect

2.1.1. Component List

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

2.1.2. Tube & Heat Pipe 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. If a tube has a white or clear bottom, it is damaged and should be replaced. The heat pipe should be removed and inserted into a replacement tube. Replacement tubes are available from your local Apricus dealer who supplied the solar collector.

b) As soon as the evacuated tubes are removed from the box, please put on the rubber tube caps, which are located in the manifold box. This will protect the bottom tip of the glass tube from being broken if knocked.

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 perfectly 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, sufficient to cause serious skin burns. The outer glass surface will not become hot. NEVER TOUCH THE INSIDE OF THE EVACUATED TUBE OR HEAT PIPE TIP AFTER EXPOSURE TO SUNLIGHT. WEAR THICK LEATHER GLOVES IF HANDLING THE HEAT PIPE.

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

2.1.3. Frame

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

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

c) For each frame front track, there are two extra sets of bolts that can be used for securing the roof attachment straps.

2.2 System Design

2.2.1. System Design

a) 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 your solar heating system. Only certified Apricus installers are permitted to install the solar collector. Apricus does not provide warranty coverage for solar collectors that are installed by unauthorized persons.

2.2.2. Delta-T Controller Settings

a) Usually a Delta-T ON value of 7-10^{o}C / 12-18^{o}F and Delta-T OFF value of 2^{o}C / 3.6^{o}F is appropriate. These setting may need to be altered slightly according to the location and system design. Refer to the instruction manual provided with the chosen Delta-T controller for appropriate settings.

2.2.3. Stagnation and Overheating

b) 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 values, plumbing or insulation, should be suitably rated.

c) If the system is designed to allow stagnation of the collector when the tank reaches a set maximum level, steam will form in the header. In such a system, a temperature relief valve or auto air vent should NOT be installed on the collector outlet, as they may not be able to withstand the high temperatures, and will not allow stable stagnation of the collector. After a period of stagnation, some steam may feed back into the storage tank via the return line. The pressure and temperature relief value 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 around 160°C / 320°F. The heat returning from the collector in the form of steam is generally not enough to cause a continued increase in tank temperatures (ie. Heat input < tank heat losses), and therefore is able to meet requirements in force in some regions regarding regulating tank hot water dumping.

2.2.4. Correct System Sizing to Avoid Overheating

a) The system should be sized so that overheating of the tank is difficult to achieve in a single day, even during hot, sunny periods. If the system is over-sized, such that excessive heat is often produced during summer months, an Apricus Heat Dissipater unit should be installed.

2.2.5. Solar for Central Heating – Preventing Overheating

a) If a system has been designed to provide contribution to central heating, it will often provide much more heat in the summer than is required for hot water supply alone. In such cases it is advisable for the home to have a spa or pool that can use the heat in the summer period or an Apricus Heat Dissipater unit be installed. See also the following point (2.2.6), regarding reduction of summer heat output.

2.2.6. Adjusting Collector Angle to Ease Overheating

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

2.2.7. Collector Direction

a) The collector should face the equator, which if in the Northern hemisphere is due South, and vice versa. Facing the collector in the correct direction and at the correct angle is important to ensure optimal heat output from the collector, however a deviation of up to 10° from due North or South is acceptable, and will have minimal effect on heat output

2.2.8. Collector Plane

a) The collector manifold is normally installed on the flat horizontal plane, but may be installed at and angle of +/-5° from horizontal as may be required if installing in a drain-back configuration.

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.

2.2.9. Collector Angle

a) It is common for collectors to be installed at an angle that corresponds to the latitude of the location. While adhering to this guideline, an angle of latitude +/- 10° is acceptable, and will not greatly reduce solar output. See also point 2.2.6.

b) The solar collector should be installed at an angle of between 20-80° to ensure optimal heat pipe operation.

2.2.10. Avoid Shade

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

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

2.2.11. Location

a) The collector should be positioned as close as possible to the storage cylinder to avoid long pipe runs. Storage cylinder positioning should therefore consider the location requirements of the solar collector.

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

2.2.12. Expansion Vessel – Minimising water wastage

a) In any hot water system, be it solar, gas, electric or combination thereof, expansion of water will occur as the water heats up. When water expands it has to go somewhere, as it cannot be compressed like air.

b) In open loop systems that have a check valve/non-return valve on the cold mains, this water is released via the pressure release valve, which is mounted on the tank or solar collector loop. In order to prevent this wasteful dumping of water, it is recommended that an expansion vessel be installed.

c) Closed loop systems should always be installed with an expansion vessel. The volume of the vessel usually equates to 2-3% of the volume of the water in the system. Refer to the expansion vessel manufacturers' guidelines regarding correct sizing.

2.2.13. Lightning Protection

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

2.2.14. Pipe Connections & Pipe Size

a) Apricus solar collectors are provided as standard with 22mm OD copper pipe inlet and outlet pipe.

b) Connection to the inlet and outlet may be by use of brass compression fittings (with copper olive), or low temperature soldering.

c) For domestic heating applications with 2 collectors or less, nominal 15mm / ½" piping is suitable.

d) For applications using 2 or more solar collectors in series, it is advisable to use a nominal 20mm / 3/4" piping.

e) For connection of banks of collectors, larger pipe sizes should be used as specified for the given application, with consideration made to flow rates, pressure drop and pump sizing.

f) The material used for the solar line must be able to withstand the operating temperatures and pressures that the system may be exposed to, due both normal and extraordinary conditions (eg. Pump failure, or power outage). Copper pipe is the most widely used piping material for solar applications. If it is decided to use synthetic piping for the plumbing, Apricus strongly recommends that copper pipe is still used for at least the most proximal 2m / 12feet of the line connecting to both the inlet and outlet of the collector.

2.2.15. Connection of Multiple Collectors

a) When connecting collectors in series (maximum of 150 tubes), flexible connections should be used between each collector, in order to allow for the expansion and contraction of the copper header with temperature changes. Failure to use flexible connections between consecutive collectors may result in damage to the header if the system stagnates. *Apricus does not warrant the collector against damage resulting from poorly managed header expansion and contraction.*

2.3 Mounting Frame

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 off walls, additional frame kits are available. Depending on the roof surface, the standard frame may attached to the roof with rubber pads (corrugated iron, asphalt), roof attachment straps (tiled roofs), or round feet (asphalt).

2.3.1. Frame Material

a) All frame components are made of 1.5mm thick stainless steel making the frame both strong and corrosion resistant. It is important that frame attachment points and externally supplied fasteners are also of suitable structural strength.

2.3.2. Galvanic Reaction Between SS and Zinc Galvanised Steel

a) Zinc or Zn/Al 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 iron (corrugated iron), refer to section 2.4.4 for installation guidelines.

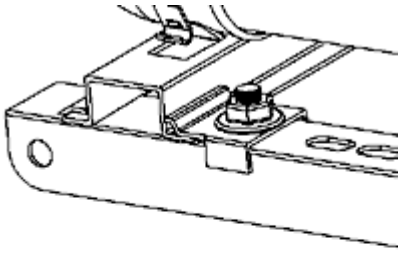
c) Avoid using galvanized steel bolts; instead use stainless steel components. If galvanized components are used, avoid direct contact between the two metals by using the rubber/plastic separators, such as the Apricus rubber frame pad (Part #: FR-SRPAD, FR-TRPAD). See also 2.4.4.

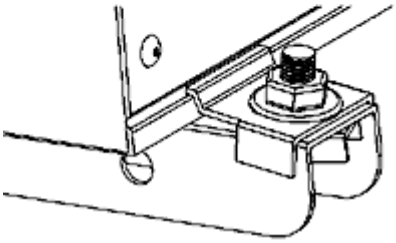
2.3.3. Roof Installation

Three types of roof installations are outlined in this guide:

1. Flush installation on a suitably roof. See section 2.4
2. Installing on a roof with insufficient pitch. See section 2.5
3. Installing on a flat surface. See section 2.6
4. Installing off a wall. Section 2.7

2.3.4. 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 clips are designed such that when loose, the manifold and bottom track are able to slide left and right. This allows the front tracks to easily be adjusted to suit the roofing surface.

c) Once correctly located the nuts should be tightened using the supplied spanner, locking the manifold and bottom track in place.

d) Note that the bolts are up-side-down with the nut on top. This allows the thread to be viewed and as such prevents the installer from loosening the bolt so much that the nut drops off. The bolt head is prevented from rotating by use of a nut lock, preventing the need to use a second spanner.

2.3.5. Customizing the Frame

a) The standard frame, low, mid, high and fixed angle roof frame components can be used creatively to suit a range of different installation surfaces. Additional holes may be drilled in the frame as required, but the frame structural integrity must not be compromised (E.g., drilling holes too close together).

For examples of customized frame installations, please view the photo gallery on the Apricus website by visiting: http://www.apricus.com/html/solar_collector_photo_gallery.htm

2.4 Flush Pitched Roof Installation (Standard Frame)

Refer to Appendix A for assembly diagram.

2.4.1. Installation Planning

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

2.4.2. Positioning Manifold

a) The manifold and bottom track can slide left and right in relation to the frame front tracks, so there is some flexibility when selecting the location. The frame front tracks should be located such that they lay flat and even on the roof (match the tiles/shingles) and also line up with the roof frame.

b) If possible try to locate front tracks under the 2nd or 3rd tube from each end. By locating the front tracks directly under the evacuated tubes, the stainless steel frame will be hidden, improving the aesthetics of the installation. For collectors with three front tracks the middle front track should be positioned roughly centrally, again ideally behind a tube.

2.4.3. Tiled Roof Attachment

a) For tiled roofs, the 60cm / ~2' or 100cm / ~3' long roof attachment straps can be used (2 per front track). One end of each strap should be secured to the underside of the frame front tracks using the supplied M8-20 bolts and nut lock assemblies, the other end to structurally secure roof framing using M8 (8mm / 0.3" diameter) or thicker bolts or screws. Please ensure that roof-anchoring points are of suitable structural integrity. Once the upper straps are attached and tightened, adjust the bottom straps to ensure that they too are providing support to the frame.

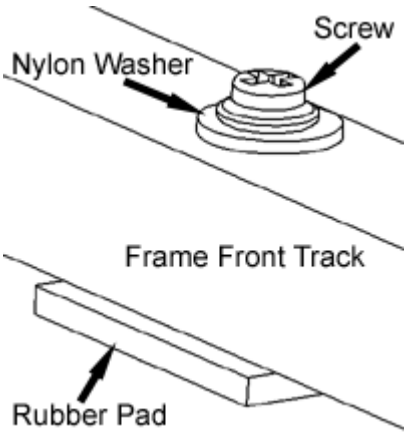
2.4.4. Corrugated Iron Roof

a) For installation on a corrugated iron roof, the standard thickness rubber pad can be used to separate the frame from the roof and also to seal the hole. Use a standard corrugated iron roofing screw to secure the frame front track directly to the roof's wooden frame (addition holes may need to be drilled in the frame front track).

b) If the roofing screw is galvanized iron, it should have a rubber/nylon washer, which will prevent direct contact with the stainless steel frame.

c) The rubber pad will form a tight seal against the roof, preventing any water ingress (addition of some silicone sealant beneath the pad may be required).

d) This mounting method is also suitable when attaching the roof tracks used in the low or mid angle roof frame when using the roof track option. (See section 2.5)



2.4.5. Asphalt Shingle Roof

a) For installation on an asphalt shingle roof, the same method as outlined in 2.4.4 can be used, with the difference that the extra thick rubber pad should be used, as the pad will sink into the asphalt by a small distance.

2.4.6. Correctly Align Frame

a) Please make sure that the front tracks are both parallel and level before attaching the manifold or bottom track. Using a string to check the diagonal distance between the top of one track the bottom of the next (should be equal) is a quick and easy method to use. An uneven or unparallel frame may result in damage to the system, in particular, the evacuated tubes.

2.4.7. Manifold and Bottom Track Attachment

a) Once the front tracks are secured in place, the manifold and bottom track may be attached, taking care to ensure they are correctly aligned. Both the manifold and bottom track will lock into the frame,

secured from above with the attachment plates that are already in place.

2.5 Low Pitched Roof Installation (Low or Mid Roof Frame)

Refer to Appendix B & C for assembly diagrams.

If the roof pitch is insufficient, the low or mid angle roof frame kit can be used to increase the angle by 12° or 27° respectively. The low or mid angle frame kits combine with the standard frame components to form complete frames.

2.5.1. Frame Options

a) Two frame options are available, round feet or roof tracks.

- Round Feet are suitable for attachment to concrete or asphalt shingle roofs on which the round foot twin bolt attachment is preferred. Round feet allow some front and back movement of the rear legs, thus slightly adjusting the install angle.
- Roof tracks are ideal when rubber pads are the preferred attachment method and provide a fixed install angle. Connection of the roof tracks should be completed in the same way as the front tracks, outlined in section 2.4.
- In cases where either option is viable, round feet provide the most cost effective solution.

2.5.2. Rear X Brace Adjustment

a) If the location of the front tracks and rear legs needs to be adjusted to match the roof frame, customization of the rear X brace may be required. If this is the case, the rear X brace struts must be cut to length, and 9mm / 0.35” holes drilled to suit.

2.6 Flat Roof Installation (High Angle Frame)

The high angle frame is appropriate for installations on flat surfaces and provides adjustment from 30-50°. The high angle frame kit combines with the standard frame components to form the complete frame. Refer to Appendix D for assembly diagram.

2.6.1. Frame Feet Anchoring

a) Frame feet should be bolted to the installation surface using 10mm / 0.4” diameter or larger bolts, or a similarly sturdy fastening method.

b) Ensure the surface is solid and able to withstand the significant "pull" force that may be encountered during high winds.

c) If concrete blocks are used under each foot (ie not directly bolted into the roof), they should weigh at least 30kg / 66pounds each, or >40kg / 88pounds for areas prone to high winds.

2.6.2. Adjusting Frame Angle

a) The rear legs of the high angle frame comprise two interlocking pieces (top and bottom leg), which allow the length of the rear leg to be adjusted, thus changing the collector angle from between 30 and 50°.

b) Each pair of legs (top and bottom) must always be attached together by 2 bolts (two sets of holes).

b) If an angle less than 30° is required the top rear leg may be cut short (the bottom leg is not used). In such cases the rear X brace components will need to be cut shorter, and additional holes may need to be drilled to ensure correct alignment. Rather than making adjustments to the high angle frame, it is much easier to directly use a low or mid angle frame. See Appendix B & C.

2.7 Wall Mounting (using Low, Mid, High or Fixed Angle Frames)

Refer to Appendix F for assembly diagram.

2.7.1. Wall Frame Options

a) If mounting on a wall, the low, mid, high or fixed angle frames may be used, with the legs reversed, so attached to the bottom of the front tracks rather than the top.

b) Rear legs should be positioned perpendicular to the wall's surface to ensure optimal frame strength and stability.

2.7.2. Attachment Methods

a) The method used for attachment to the wall will depend on the wall material. For brick or concrete walls, the round feet can be used, attached with standard expansion bolts.

b) For wood or synthetic boarding, screws that can penetrate into the wall framework may be suitable.

c) Always consider the weight of the collector and the structural integrity of the wall. Apricus recommends (and it may be a legal requirement) that installations be inspected and approved by authorized building inspectors.

d) Take note to adhere to the maximum collector angle of 80^{o}, otherwise heat transfer performance may be reduced.

e) When installing on a wall consider the possible shading from eves, particularly in the summer. This in fact may be a part of the system design, in order to minimize summer heat output. Another advantage of installing under an eve overhang is to minimize snow buildup on the collector in areas with regular snowfall.

f) If using round feet at the top of the front tracks to bolt to the wall, the rear corners of the manifold attachment plates will need to be corners ground slightly to allow for the round foot.

g) If installing on a wall such that the collector is above a walkway, or area where people may pass by, please consider the danger associated with broken glass that could fall if the tubes were ever damaged. (Eg. During an extreme storm, due to flying debris, or tree branch falling on the collector). It may be necessary for a barrier of some description to be installed below the collector to catch any such falling materials.

2.8 Connection to Plumbing

2.8.1. Plumbing Connection

a) Once the frame has been mounted and the manifold attached, the manifold header may be connected to the system plumbing.

b) If the collector is to be installed (including evacuated tubes) prior to plumbing connection (Eg. on new house), high temperature resistant covers should be placed over the header inlet and outlet to prevent any contaminants entering the header (Eg. aluminum foil). The solar collector will not be damaged by a short period of dry stagnation (<1 month).

2.8.2. Temperature Sensor Insertion

a) The temperature sensor port is located beside the inlet and outlet ports. Generally the temperature should be is sensed at the outlet of the manifold.

b) The solar controller's temperature sensor should be coated with a thick layer of thermal paste and inserted into the sensor port to the full depth. If the fit is too loose, slide a piece of copper or stainless steel plate/wire in beside the sensor.

b) Seal the sensor port opening with silicone sealant to prevent water ingress, or ensure that the insulation foam tightly covers the opening.

c) Ensure that sensors used on the collector are high temperature rated (up to 200^{o}C / 395^{o}F), in particular the cable.

2.8.3. Sweating/Soldering Connection

a) Where sweating/soldering is the preferred attachment method for copper pipe, this method may be used to connect to the manifold inlet and outlet.

b) The silicone rubber seal around the copper pipe is able with withstand high temperatures, but care

should still be taken to avoid overheating the copper pipe. If possible use a wet rag around the pipe close to the rubber seal to reduce temperature transfer. Also take care not to expose the powder coated casing to direct flame.

c) *Apricus will not be held responsible for damage to the collector resulting from flame/heat related damage.*

2.8.4. Compression Fitting Connection

a) Always use two opposing spanners when tightening the compression fittings. DO NOT twist the copper pipe as the header may be damaged.

b) It is advisable to use a small spray of WD-40 or similar on the fitting threads to ensure smooth tightening process.

c) DO NOT OVERTIGHTEN THE COMPRESSION FITTING. Tighten with standard length spanners using moderate torque force. NEVER USE EXTENSION PIPES on the spanners.

d) Flood the circuit with water and check for leaks at the compression fitting. If leaking turn an additional ¼ to ½ turn to form a sound seal. Do not continue to tighten beyond this torque level!

2.8.5. Air Purge

a) Once the inlet and outlet are connected to the plumbing system, the collector loop should be purged of air (see also 2.8.3).

b) Mains Pressure Open Loop – for a system without an auto-air vent installed, opening up the hot water taps in the house and operating the pump at full speed should eliminate all air from the system. 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.

c) Low Pressure 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.

d) Closed Loop – the solar loop should be filled with glycol/water mix, 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/heat exchanger used.

2.8.6. Plumbing Check

a) Once plumbing is confirmed as leak free and with all air having been purged, the heat pipes and evacuated tubes may be installed.

b) In some cases the solar collectors may be fully installed before the plumbing is connected (See 2.7.1)

c) If the plumbing is fully connected but NOT to be flooded with liquid until some time after evacuated tube insertion then precautions should be taken to prevent damaged associated with collector high temperatures. If auto-air vents, insulation or other low temp rated (<200^{o}C / 395^{o}F) components are installed in close proximity to the collector, the evacuated tubes should be covered to prevent exposure to sunlight until the system is flooded and normal system operation established. If the system is designed to allow stagnation, and therefore components high temperature rated, exposure to sunlight prior to system operation is acceptable for up to one month.

d) When flooding a system that is sitting hot and dry, loud cracking sounds may be heard coming from the header, as the water contacts the hot copper header and forms steam. This is normal. If the system is using a glycol-water mix, it is advisable to only flood the system when cool (late evening, rainy day, or cover the tubes for several hours), otherwise the high temperatures may damage the glycol.

2.8.7. 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 25mm/1” or even thicker in cold climates. Heat loss from the piping can be significant, and so particular attention should be taken to insulate any possible points of heat loss.

b) Ensure the insulation is tight against the manifold casing, thus minimising loss of heat from the inlet and outlet. In order to prevent water from entering the temperature probe port and/or in between the piping and insulation foam, a high quality silicone sealant should be used to form a water-tight seal between the manifold casing and the insulation material.

c) Insulation foam that is exposed to direct sunlight should be protected against UV related degradation

by wrapping/covering with a suitable material such as adhesive back aluminum foil, PVC conduit or similar.

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 a foil or similar watertight and UV stabilized material such as adhesive backed aluminium foil.

e) Circulation pumps can be a source of significant heat loss and should be insulated. Some pumps come standard with a molded polystyrene casing which has good insulation properties. If the pump does not have any insulation, the same rubber style insulation used on the plumbing pipe can be used to cover the pump, secured in place with good quality nylon cable ties or adhesive tape.

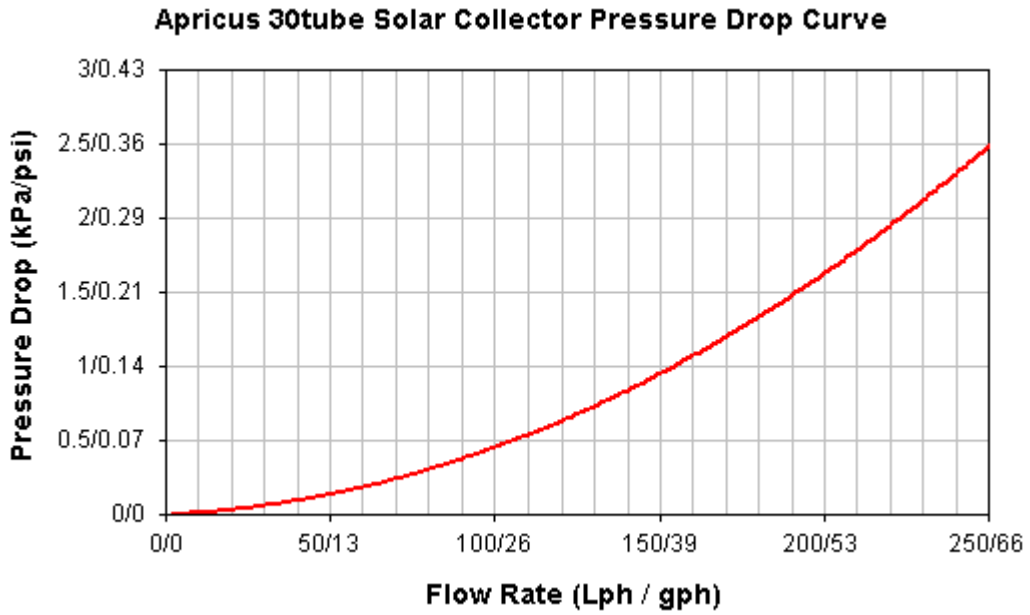
f) All internal piping as well as external should be insulated. This includes at least the 1m / 3" closest to the hot water outlet of the tank, as this copper pipe is a significant point of passive heat loss.

2.8.8. Pump Selection

a) The pump should provide enough pressure to enable circulation through the collector header, but preferably only at a slow rate (0.1L/tube / 0.026G/tube each minute). Apart from wasting electricity, a fast flow rate will cause turbulent mixing of the water in the storage tank, disturbing temperature stratification, which is not desirable.

b) If the water pressure used in the solar loop is sufficient to fill the header passively, then the pump is simply required to circulate the water. The key consideration is therefore the pressure drop throughout the pipeline. Elbows, Ts, and bends in piping all contribute to pressure drop. For this reason the flow path should be kept as simple and unrestricted as possible.

c) Pressure drop through an Apricus 30 tube header at 3L/min and 40°C / 104°F is only 1.3kPa / 0.19psi, so is virtually negligible when considering pump sizing. See graph below for pressure drops at flow rates up to 250L/hour / 66gph. Pressure drop at temperatures above 40°C / 104°F will be lower than displayed below.



d) For single storey/floor houses where the pipe run to and from the collector is no more than about 8m / 27feet, a small 25-30Watt pump with low head pressure (~50kPa / 7psi) may be sufficient. 2 or 3 storey houses where the pump run is longer, a 60-70Watt pump may be required. The use of a 3 speed pump is ideal, as an appropriate speed setting can easily be chosen (Eg. 40, 60 & 90Watt settings).

e) To determine if the pump chosen is suitable the following methods can be used:

1. If a flow meter is installed on the return flow line, a visual indication of flow rates can be provided.
2. If a flow meter is NOT installed, observing pump operation can reveal if sufficient flow is being achieved. Under normal conditions with sunny weather the pump should cycle on and off. If the pump is cycling more than once every 2-3minutes, or indeed running continuously the flow

rate may be insufficient. A faster than required flow rate might be indicated by a very short pump operation time of less than 20seconds.

3. If a solar controller with LCD temperature display is used, the solar collector and tank temperatures may be monitored. Under normal operation, the manifold temperature should gradually increase (speed will depend on solar radiation levels). In good sun it should only take 3-5min for the manifold to increase to the Delta-T ON level (~7-10°C / 12-18°F). Once the pump turns on, the header temperature should initially increase by 2-3 degrees as the hot water in the header passes by the sensor. Over a subsequent period of 30-60seconds the header temperature should gradually drop back down, the pump turning off once the Delta-T OFF level is reached.

If the manifold temperature does not gradually decrease once the pump turns on, then it may indicate insufficient circulation. If the temperature drops too quickly, the circulation speed may be faster than required, wasting electricity, and causing unnecessary turbulence on return to the storage tank (if applicable).

f) Always use hot water rated pumps (up to 110°C / 232°F), as temperatures close to boiling can be experienced. The pump should always be installed on the TO COLLECTOR line, thus reducing exposure to high temperatures.

2.9 Evacuated tube & Heat Pipe Installation

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

DO NOT INSTALL THE HEAT PIPES AND EVACUATED TUBES UNTIL SYSTEM PLUMBING IS COMPLETED AND PUMP AND CONTROLLER ARE OPERATIONAL, UNLESS THE SYSTEM, IN PARTICULAR INSULATION, IS DESIGNED TO WITHSTAND HIGH TEMPERAPURE STAGNATION, OR TUBES ARE COVERED.

Please follow the instructions below for assembly and installation:

2.8.1. Unpacking

a) The heat pipes and evacuated tubes are packed in the same box, with heat pipes already inserted into the evacuated tubes.

b) Place a rubber cap onto the bottom of each evacuated tube as it is removed from the box.

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

d) Heat pipes contain a small amount of metallic powder which aids in heat transfer and provide protection against freeze related damage to the heat pipe. If the boxes of tubes have been transported as per the arrows on the boxes, either standing up or lying down, the powder should already be situated at the bottom of the heat pipe, where is needs to be. If at any stage the box of tubes or individual tubes have been inverted (turned up-side-down), please complete the following:

1. Turn the tube (with heat pipe inserted) so the heat pipe tip is pointing downward, and shake up and down 5-6 times.
2. Turn tube up the correct way (heat pipe tip up) and repeat shaking again. This will allow the water to carry the powder down to the bottom of the heat pipe.
3. Do not lay the tubes totally flat, or turn them up-side-down again prior to installation – if they are, steps 1 & 2 must be repeated.

2.8.2. Heat Pipe and Evacuated Tube Insertion

a) The heat pipe will already be inserted full into the evacuated tube. The heat pipe should be pulled out by about 5cm / 2” to ensure that it can be fully inserted into the header before pushing the tube into place. In doing this, the heat transfer fin may also be pulled outward, this is not a problem, as it will return into place as the tube is inserted fully.

b) If an evacuated tube is damaged for any reason (Eg 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 inserted the heat pipe from the broken tube into the new tube. This should be done with care, holding the heat pipe close to the tube opening and inserting by making a short push and twisting action. Never throw heat pipes away, as they are very sturdy and will not be damaged even if the tube has been. They can be kept as spares, or inserted into plain spare evacuated tubes.

c) Using the heat transfer paste, form a ring (like a donut) around the head of the heat pipe tip. Ideally also insert a little into the heat pipe ports in the manifold. *Note:* The powder content of the thermal paste may have settled during storage and freight – in order to ensure optimal thermal conductivity, it is advisable to sit the tube (cap downward) in a glass of warm water (particularly in cool weather) to allow the powder to mix through. This will also allow the paste to become thinner, allowing easier application and heat pipe insertion.

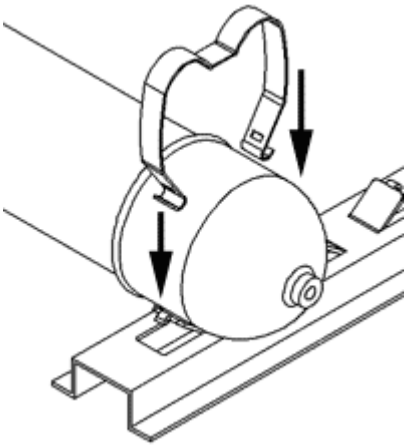
e) Lubricate the top outer surface of the evacuated tube with a small amount of water. This facilitates easy insertion past the manifold rubber ring seal. A small pump spray bottle is the best method for carrying and applying the water. *Note:* **DO NOT SPRAY WATER INTO THE EVACUATED TUBE**

f) Whilst firmly holding the evacuated tube, guide the heat pipe tip in past the manifold rubber seal, and into the heat pipe port. As it is a tight fit, it may not insert fully – see next step.

g) Using a slight (1/8th turn) left and right twisting action, push the evacuated tube up into the manifold. The neck of the evacuated tube will push against the rubber ring at the base of the heat pipe tip, forcing it fully into the port.

h) 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.

i) 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 over the rubber cap while favouring one side until a “click” sound is heard.

Step 2) While **centralizing** the clip over the top of the rubber cap, push down the other side until it too “clicks” into position.

Step 3) Check to ensure both sides are correctly clipped over the hooks.

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

k) 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.

2.8.3. Post Installation Cleaning

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

2.10 Post Installation

2.9.1. Collector Operation

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

2.11 Precautions

2.11.1. Metallic Components

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

2.11.2. Evacuated tubes

a) Be careful when handling the evacuated tubes, as they will break if knocked heavily or dropped. Wear gloves if handling any broken glass.

2.11.3. High Temperatures

a) With the heat pipe installed in the evacuated tube, and good sunlight, the heat pipe tip can reach temperatures in excess of 200°C / 392°F. At this temperature touching the heat pipe will result in serious burns, so thick leather gloves must be worn when handling hot tubes and heat pipes.

b) In an installed fully plumbed system, if the pump is stopped during good sunlight the collector header and plumbing pipe close to the manifold can easily reach temperatures in excess of 160°C / 320°F, and therefore caution should be taken when handling such components.

2.11.4. Broken Glass

a) If the evacuated tubes are struck by a hard object with sufficient force (Branch falling on roof), they may break. During installation consideration should be taken as to the possible path any broken glass may take. Where possible protection should be implemented to prevent broken glass from reaching ground level where somebody could walk on it (Eg. Guttering on roof).

b) The home owner should be made aware by the Installation Officer, the location of the solar collector and the possible vicinity of broken glass in the event of an extreme storm or falling object on the collector.

2.11.5. Health & Safety

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

3. 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.

APART FROM THOSE MAINTENANCE ITEMS OUTLINED BELOW, ANY SYSTEM INSPECTION, MAINTENACE OR REPAIR SHOULD ONLY BE COMPLETED BY AUTHORIZED PERSONS. THE SOLAR COLLECTOR WARRANTY COVERAGE MAY BE VOID IF NON-AUTHORISED PERSONS ATTEMPT TO MAINTAIN OR REPAIR THE SOLAR COLLECTOR OR ASSOCIATED COMPONENTS.

The following basic maintenance may be completed by the HOME OWNER:

3.1. Cleaning

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

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

3.2. Leaves

a) During autumn, leaves may accumulate between or beneath the tubes. Please remove these leaves regularly to ensure optimal performance and to prevent a fire hazard. (The solar collector will not cause the ignition of flammable materials). Such cleaning may only be completed by the homeowner if the tubes are easily and safely accessible (refer also to 3.1 for safety considerations)

The following maintenance may only be completed by AUTHORIZED PERSONS:

3.3. Broken Tube

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

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

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

d) To replace a tube:

-Remove the tube clip(s), slide broken tube out and carefully pick up any glass pieces. Protective gloves must be worn when handling broken glass.

- 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.

- Avoid touching the glass wool insulation with bare hands, as it can cause mild skin irritation.

- If the heat pipe is not easily removed, it can be left in place and a new evacuated tube inserted, guiding the heat pipe down the groove between the evacuated tube inner wall and heat transfer fin.

– If the heat pipe is easily removed, the easiest option is to replace the heat pipe and evacuated completely.

3.4. 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.

3.5. 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).

To drain the collector of fresh water (direct flow system):

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

Step 2. If the storage tank or other system components are being concurrently drained, refer to their instruction manuals for details. If storage tank is not being drained, isolate piping to and from the solar collector (isolation valves should already be installed), and open drain cocks on both lines (or undo fittings). **In good weather the water may be hot, or have built up pressure so take care.**

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

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

Step 5. Close the air vent or drain cock, or re-fasten fitting.

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

3.6. 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.

4. 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 a, authorized persons only.

4.1. No Hot Water

a) If there is no hot water, it will generally be related to the gas or electric heating system, and not the solar collector. The collector pre-heats water, with final boosting completed by the electric element or gas booster system. For a retrofitted solar system, please contact the manufacturer/installer of your gas/electric water heater. For a new solar water heating system, please contact the company that supplied and installed the system.

4.2. Reduced Solar Contribution

a) Solar contribution to your heating is directly related to the amount of solar radiation and the volume of hot water used. During the winter, and periods of rainy, or particularly overcast weather, the amount of energy produced by the solar collector will be greatly reduced.

b) As a general rule, the solar collector will have been sized to provide close to 100% of your summer hot water needs, which, depending on your location and hot water usage patterns, may result in between 40% - 70% of your annual hot water energy needs. During the winter, increased cloud cover and reduced solar radiation levels may result in solar contribution as low as 20%. This is normal.

c) If, given similar environmental conditions, you feel that the solar contribution (as indicated by energy savings) has considerably reduced; there may be a problem with your solar heating system. This may be due to an incorrectly configured controller, pump malfunction or problem with the boosting system. In such cases please contact the company who supplied and installed the system.

Investigation

(H) 1. Does the circulation pump appear to be operating? In good sunny weather the circulation pump should come on for 1-2 minutes once every 5 to 10 minutes. The pump may run very quietly, and so you may need to touch the pump or piping running to and from with a solid object to feel for motor operation (slight vibration). ***Do not use fingers as it may be hot!!***

(H) 2. Are all the evacuated tubes intact? If a tube has been damaged or discolored it will reduce the system performance and should be replaced. If a tube is damaged, do not attempt to remove it; contact the company who supplied and installed the system.

(H) 3. Are there any apparent leaks in the pluming to and from the collector? Any water trails down the roof, or around the storage tank?

4.3. Regular Water Dumping

a) During normal daily hot water use, if the temperature release valve on the tank or collector is regularly dumping hot water, it may indicate a problem with the system.

Possible Causes:

1. The system has been sized incorrectly (oversized). This will be most apparent in the summer months, when solar radiation levels are high.
2. The pump has failed, or electrical supply to the controller and pump has been compromised.
3. A problem exists with the electric heating thermostat (Electric boosting only).

Investigation

(H) To test the system, run the hot water tap in the bathroom or kitchen for 5 minutes to release some heat from the system (the water will be hot, so be careful). If after this period, the tank or collector is still regularly venting hot water it indicates a problem. Please contact the company who supplied and installed the system to organize a service call.

5. Warranty

For any solar collector related problems and indeed warranty claims, please contact the company that supplied and installed the solar collector. They will help you to process the warranty claim and ensure your system is repaired and operating normally. Below is the Warranty Policy for the Apricus solar collector:

WARRANTY POLICY

of

APRICUS SOLAR CO., LTD.

This Warranty Policy (this "Policy") is issued by Apricus Solar Co., Ltd. ("Apricus") and applies to the various products and components of products manufactured by Apricus discussed in this Policy ("Products") that are purchased by original end users of the Products (each, a "Customer") from authorized Apricus distributors and dealers for water heating installations Worldwide.

Installation Procedure

Upon installation of Products by an authorized Apricus installer, the Apricus dealer responsible for the sale of Product to the Customer must complete an online form made available by Apricus setting forth the installing officer's number, serial numbers of the Products, and a basic description of the installation. The Customer shall complete, and retain for its own records, a copy of Apricus' customer installation form.

Warranties

Apricus provides the various warranties set forth in this Policy subject to the terms, conditions, and exclusions provided for herein.

I. Copper Header Pipe of Solar Collector.

Apricus hereby warrants and represents that, for fifteen (15) years from the date of the delivery of any solar collector to the Customer, the copper header pipe in the solar collector shall be free from manufacturing defects resulting in leakage of heat transfer liquid when operating within specified allowable pressure limits and using approved liquids, provided that this warranty excludes:

a) Leakage from any connection to header inlet or outlet;
b) Defects resulting from exposure of the manifold header pipe to pressure exceeding 0.8Mpa/8bar/116psi;
c) Defects resulting from exposure to flow rates exceeding 15 L/min / 3.96gpm;
d) Defects resulting from the freezing of the liquid contained in the manifold header pipe;
e) Leakage of the manifold header pipe as a clear result of metallic corrosion and not structural braze failure;
f) Poor heat transfer, excessive pressure drop, or blockage of header as a result of scale formation; and
g) Installation of more than two end port manifolds in series without flexible connections at least once every second manifold.

For a Customer to receive any remedies in connection with a breach of this warranty, the following conditions must be met:

a) Customer must provide to Apricus a dated photograph of the solar collector showing a water trail from the solar collector, as well as a dated photograph of the serial plate;
b) Customer must quote the serial number when making a warranty claim;
c) The solar collector that is the subject of the warranty claim must have been entered into the online installation database within thirty (30) days of the date of the completion of installation; and
d) The solar collector that is the subject of the warranty claim must be kept in storage for no less than ninety (90) days and made available for inspection by Apricus or its designee upon the request of Apricus.

II. Evacuated Tubes of Solar Collector.

Apricus hereby warrants and represents that the evacuated tubes in any solar collector shall be free from manufacturing defects resulting in spontaneous loss of vacuum for ten (10) years from the date of the delivery of such solar collector to the Customer, provided that this warranty excludes loss of vacuum due to breakage during transport, handling or after installation and that gradual reduction in vacuum levels over time are normal and accordingly are not defects in violation of this warranty.

For Customer to receive any remedies in connection with a breach of this warranty, the following conditions must be met:

a) Customer must provide to Apricus a dated photograph of the tube still installed in the solar collector showing

white bottom end and no structural tube damage; and

b) The evacuated tubes must be removed and kept in storage for no less than ninety (90) days and made available for inspection by Apricus or its designee upon the request of Apricus.

III. Heat Pipe of Solar Collector.

Apricus hereby warrants and represents that the heat pipe in any solar collector shall be free from manufacturing defects resulting in loss of heat transfer properties for ten (10) years from the date of the delivery of the solar collector to the Customer. A loss of heat transfer properties can be tested by slowly pouring 1L/2pints of hot (>60°C / 141°F) water down the bottom ¾ length of the heat pipe, whereupon the heat pipe condenser should become too hot to hold (>50°C / 122°F) in less than thirty (30) seconds.

For Customer to receive any remedies in connection with a breach of this warranty, the following conditions must be met:

a) Customer must provide to Apricus photographs of faulty heat pipes, if applicable, showing the point of failure or rupture;
b) The marking on the neck of the heat pipe must be quoted by the Customer to Apricus; and
c) The heat pipe must be kept in storage for no less than ninety (90) days and made available for inspection by Apricus or its designee upon the request of Apricus.

IV. Solar Conversion Valve.

Apricus hereby warrants and represents that any solar conversion valve shall be free from manufacturing defects resulting in structural failure causing leakage or an inability to use the solar conversion valve due to poorly formed thread for fifteen (15) years from the date of delivery of the solar conversion valve to a Customer, provided that this warranty excludes:

a) Failure due to exposure to external forces such as being dropped, or excessive torque forces on the threaded parts;
b) Leakage as a clear result of metallic corrosion and not structural failure; and
c) Leakage from threaded connections.

For Customer to receive any remedies in connection with a breach of this warranty, the following conditions must be met:

a) Customer must provide to Apricus a dated photograph of the solar conversion valve providing reasonable visual evidence of the defect; and
b) The solar conversion valve must be kept in storage for no less than ninety (90) days and made available for inspection by Apricus or its designee upon the request of Apricus.

V. Heat Dissipater.

Apricus hereby warrants and represents that, for fifteen (15) years from the date of delivery of any heat dissipater to a Customer, the heat dissipater shall be free from manufacturing defects resulting in leakage of heat transfer liquid when operating within specified allowable pressure limits (not including leakage from connection to pipe inlet or outlet), provide that this warranty excludes:

a) Failure due to exposure to external forces such as being dropped, or excessive torque forces on the threaded parts;
b) Failure as a result of the copper pipe being subjected to pressure exceeding 0.8Mpa/8bar/116psi;
c) Failure as a result of the copper pipe being subjected to flow rates exceeding 15L/min;
d) Failure as a result of liquid freezing in the copper pipe;
e) Leakage of the copper pipe as a clear result of metallic corrosion and not structural braze failure; and
f) Poor heat transfer, excessive pressure drop, or blockage of header occurring as a result of scale formation.

For Customer to receive any remedies in connection with a breach of this warranty, the following conditions must be met:

a) Customer must provide to Apricus a dated photograph of the heat dissipater providing reasonable visual evidence of the defect; and
b) The heat dissipater must be kept in storage for no less than ninety (90) days and made available for inspection by Apricus or its designee upon the request of Apricus.

Qualifications regarding Warranty

The warranties of the various Products and components thereof set forth above in this Policy shall not apply if:

a) Breaches of warranty result (i) from any use of a Product for any purpose other than its ordinary purpose, as well as any neglect, accident, or ordinary wear and tear; or (ii) from damage from transport, shipping, handling, or any act of God or other Force Majeure;
b) Breaches of warranty result from internal freezing of pipes and;
c) Breaches of warranty result from installation that is not in accordance with (i) Apricus's installation and operation manual in effect on the date when the Product is sold to the Customer, including, without limitation, any misaligned or non-leveled frame; or (ii) instructions and/or all relevant standards, codes of practice, electrical wiring and safety regulations and any regional authority regulations;

d) A solar collector is damaged because of the failure of mounting brackets, fasteners or, nails, straps or other components for solar collector mounting that are either not supplied by Apricus or not fastened according to the instructions supplied by Apricus;
e) A solar collector is damaged because of the failure to fasten it to structurally sound material, resulting in significant movement or vibration of the Product;
f) Any component of the Solar Collector is damaged as a result of exposure to wind speeds exceeding 80mph / 128km/h, or 110mph km/h / 176km/h when an additional frame front track is installed, as confirmed by reputable third party weather reports;
e) The Product is exposed to environmental conditions or mechanical forces that exceed the levels that component materials can be reasonably expected to withstand;
f) The defective part, accessory, or component of the Product was not manufactured by Apricus;
g) The Product is opened, serial tag removed or defaced, or its structure is altered in any way;
h) If any maintenance or repair on the Product is completed by un-authorized persons; and
i) The Product is relocated from its original point of installation.
j) When installed in a system using a glycol based heat transfer liquid and the solar collector is left exposed to daily sunlight without hot water usage or effective heat dissipation, such that the collector dry stagnates, with the exception of stagnation due to system component failure or power outage, where the system failure is remedied within 48 hours of occurring.
h) The solar collector is left dry (no liquid circulation) and exposed to daily sunlight (not covered) for a period of time exceeding 14 consecutive days.

Remedies for Breach of Warranty

A Customer will notify the Apricus dealer or distributor from whom it purchased a Product promptly in writing of any alleged defect in that Product. The dealer or distributor will investigate the defect to determine if it is covered by the warranty and report its findings to the Apricus distributor that sold the Product to the dealer (in the case of a dealer) and to Apricus (in all cases). Based upon such review, Apricus will have the right in its sole and absolute discretion to determine whether or not the defect violates the applicable warranty. **CUSTOMER'S SOLE AND EXCLUSIVE REMEDY WITH RESPECT TO ANY BREACH OF ANY WARRANTY (AS DETERMINED BY APRICUS IN ITS SOLE DISCRETION) BY A PRODUCT DURING THE APPLICABLE WARRANTY PERIOD WILL BE THE REPAIR OR REPLACEMENT OF THE PRODUCT BY A DESIGNEE OF APRICUS OR, IN APRICUS'S SOLE DISCRETION A REFUND OF THE PURCHASE PRICE OF THE PRODUCT TO THE CUSTOMER.** These remedies will be provided within a reasonable amount of time and without additional charge. Apricus will not be responsible for any costs or expenses associated with the investigation or analysis of an alleged defect or any repair charges for service to the Products that is not covered hereby. Apricus's total liability to Customer with respect to any Product shall be limited to Customer's purchase price for the Product. **APRICUS WILL NOT BE LIABLE TO ANY PARTY, INCLUDING THE CUSTOMER, FOR ANY CONSEQUENTIAL, EXEMPLARY, INCIDENTAL, INDIRECT, LIQUIDATED, PUNITIVE, SPECIAL, SPECULATIVE OR OTHER SIMILAR DAMAGES, INCLUDING, WITHOUT LIMITATION, ANY DAMAGES TO PROPERTY OR COST OF REPLACEMENT GOODS, RESULTING FROM ANY BREACH OF WARRANTY BY A PRODUCT OR ANY PRODUCT DEFECT.** This paragraph sets forth a Customer's sole and exclusive remedy with respect to any Product, and a Customer shall not have any other remedy or remedies at law, in equity, or otherwise.

No Other Warranties

EXCEPT TO THE EXTENT EXPRESSLY PROVIDED FOR IN THIS POLICY, APRICUS HEREBY EXPRESSLY DISCLAIMS AND EXCLUDES ANY AND ALL REPRESENTATIONS AND WARRANTIES, WHETHER WRITTEN OR ORAL, WHETHER EXPRESS OR IMPLIED, WHETHER ARISING BY CONTRACT, AT LAW, IN EQUITY, BY STRICT LIABILITY, OR OTHERWISE, WITH RESPECT TO THE PRODUCTS, INCLUDING, BUT NOT LIMITED TO, ANY WARRANTY OF MERCHANTABILITY, ANY WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, ANY WARRANTY AGAINST REDHIBITORY DEFECTS, AND ANY WARRANTY AGAINST INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS UNDER THE LAWS OF ANY JURISDICTION, INCLUDING, WITHOUT LIMITATION, ANY PATENTS, TRADEMARKS, OR COPYRIGHTS.

6. 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.

7. Installation Checklist

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

1	Collector faces as close as possible to due North/South.	□Y	□N
2	Manifold is not significantly shaded throughout the day.	□Y	□N
3	Manifold is not likely to be struck by falling objects such as branches, falling fruit, or other nearby objects	□Y	□N
4	Collector is installed at an angle of between 20° – 80°, preferably at latitude angle.	□Y	□N
5	In areas prone to large hail (>∅20mm / ∅3/4”), collector is installed at an angle of 40° or greater.	□Y	□N
6	Frame is secured to structurally sound roof/wall.	□Y	□N
7	Plumbing is leak free.	□Y	□N
8	Plumbing pipe runs are well insulated	□Y	□N
9	Insulation above roof level is protected against sunlight with 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 collector outlet and/or storage tank.	□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	Warranty document 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

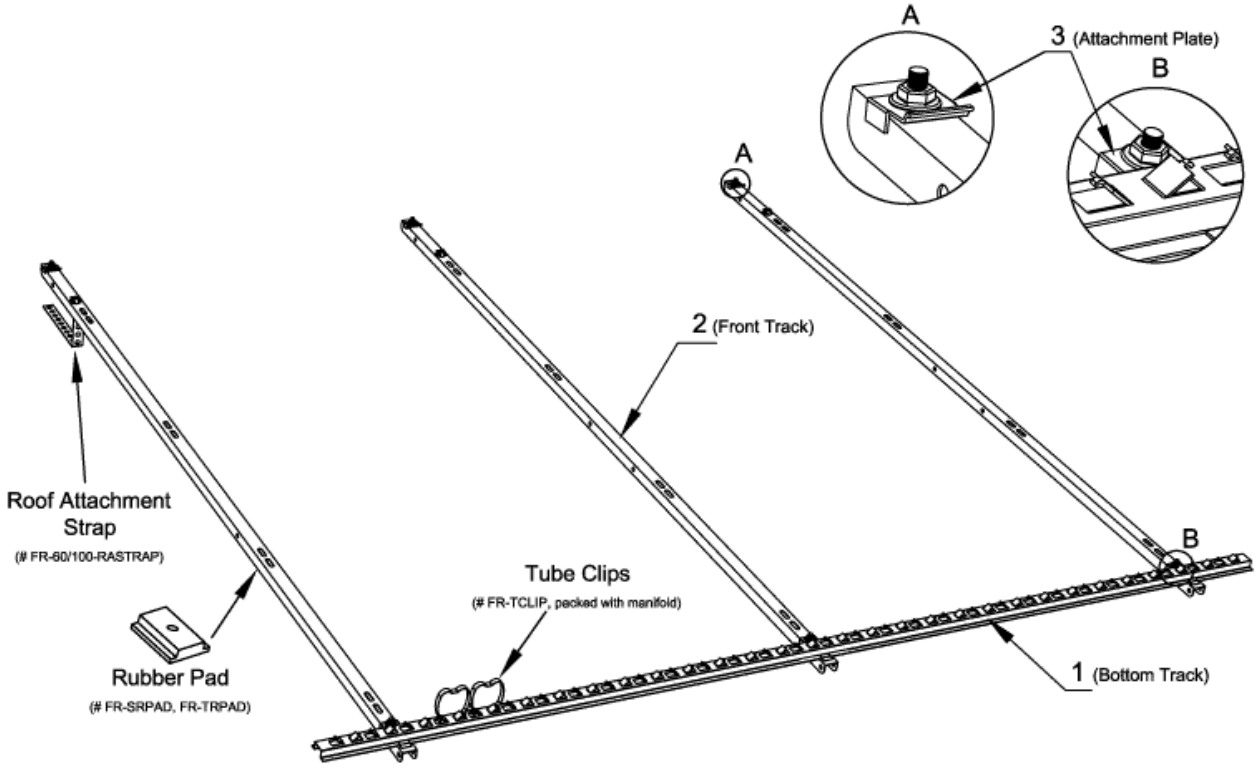
All items should be ticked **Y** for the installation to be considered completed and satisfactory.

Appendix A

Apricus Solar Collector Standard Frame Kit

Part #: FR-XX-STANDARD

This frame is suitable for flush installation on a pitched roof. If installing on a low pitched roof, or flat roof, an additional frame kit is required which will complement the components already contained in this standard frame kit.



Roof Attachment Options (Components Supplied Seperately)
Tiled Roof - *Roof Attachment Straps*
Corrugated Iron Roof - *Standard Rubber Pads*
Asphalt Shingle Roof - *Extra Thick Rubber Pads*
or
Low, Mid, High or Fixed Angle Frame Kit

SAFETY CONSIDERATIONS

- Wear gloves when handling frame components
- If installing on corrugated iron roofs, always use rubber pads, thus preventing direct contact between galvanised iron and stainless steel frame.
- Ensure roof attachment points are structurally sound
- Follow relevant safety regulations regarding working on roofs

Frame Packing List

Part #	Component Quantities	
	10 & 20 Tube	22 & 30 Tube
1. FR-BTRACK-XX	1	1
2. FR-FTRACK-XX	2	3
3. FR-APLATE	4	6
4. FR-BOLT-M8x20	*8*	*12*
5. FR-NUT-M8	*8*	*12*
6. FR-WASH-B	*4*	*6*
7. FR-WASH-S	*4*	*6*
8. FR-NLOCK	*8*	*12*

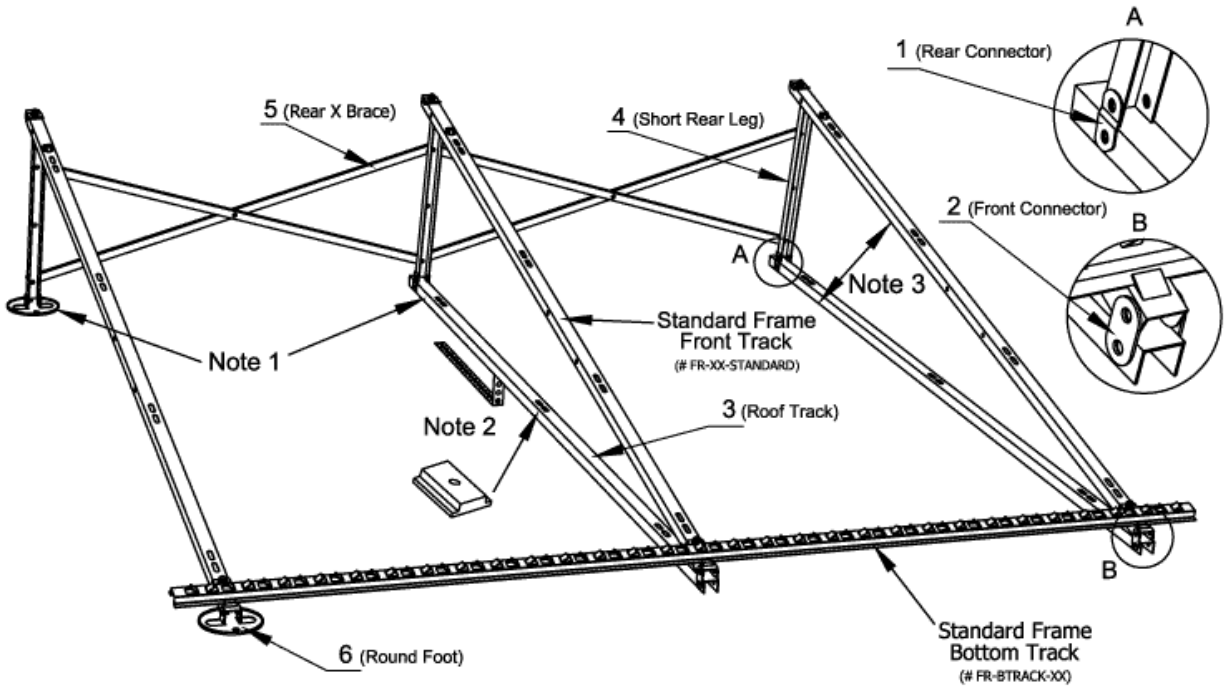
Nuts and bolts are already attached to the appropriate components.

Appendix B

Apricus Solar Collector Low Angle Frame Kit

Part #: FR-XX-LOW-RFOOT/RTRACK

The components contained in this package combine with the standard frame to form the complete frame assembly shown below.



Notes:
1. There are two mounting options, ROUND FEET or ROOF TRACKS.
2. When using the Roof Tracks, attachment to roof may be via roof attachment straps (# FR-60/100-RASTRAP) or rubber pads (# FR-SRPAD, FR-TRPAD) depending on roof surface.
3. ROUND FEET provided adjustable angle of 11-13deg. ROOF TRACKS provides a set angle of 12deg.

Nuts and bolts are already attached to the appropriate components.

SAFETY CONSIDERATIONS

- Wear gloves when handling frame components
- If installing on galvanised iron roofs, always use rubber pads or rubber feet covers to preventing direct contact between galvanised iron and stainless steel frame.
- Ensure roof attachment points are structurally sound
- Follow relevant safety regulations regarding working on roofs

Frame Packing List

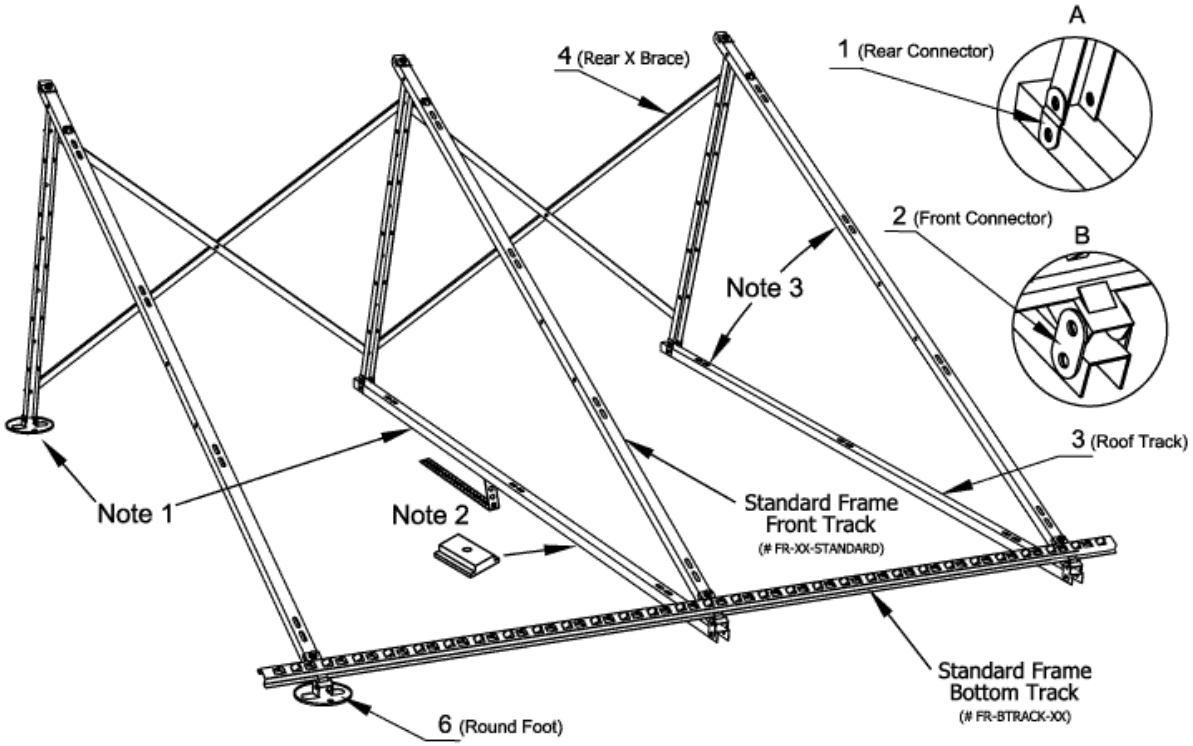
Part #	Component Quantities			
	10 & 20 Tube		22 & 30 Tube	
	FEET	R.TRACK	FEET	R.TRACK
1. FR-FCON	4		6	
2. FR-RCON	4		6	
3. FR-RTRACK	-	2	-	3
4. FR-SRLEG	2		3	
5. FR-RXB-MID-XX	2		4	
6. FR-RFOOT	4	-	6	-
7. FR-BOLT-M8x50	*4*	*10*	*9*	*15*
8. FR-BOLT-M8x40	-	-	*2*	*2*
9. FR-BOLT-M8x20	*5*	*5*	*6*	*6*
10. FR-NUT-M8	*17*	*25*	*26*	*38*
11. FR-WASH-S	*17*	*25*	*26*	*38*
12. FR-WASH-B	*8*	*4*	*12*	*6*
13. FR-NLOCK	*5*	*5*	*8*	*8*
14. FR-SPAN-12/14	1			

Appendix C

Apricus Solar Collector Mid Angle Frame Kit

Part #: FR-XX-MID-RFOOT/RTRACK

The components contained in this package combine with the standard frame to form the complete frame assembly shown below.



Notes:

1. There are two mounting options, ROUND FEET or ROOF TRACKS.
2. When using the Roof Tracks, attachment to roof may be via roof attachment straps (# FR-60/100-RASTRAP) or rubber pads (# FR-SRPAD, FR-TRPAD) depending on roof surface.
3. ROUND FEET provided an adjustable angle of 21-28deg. ROOF TRACKS provide a set angle of 27deg.

Nuts and bolts are already attached to the appropriate components.

SAFETY CONSIDERATIONS

- Wear gloves when handling frame components
- Feet must be bolted to ground
- Ensure attachment points are structurally sound
- Follow relevant safety regulations regarding working on roofs

Frame Packing List

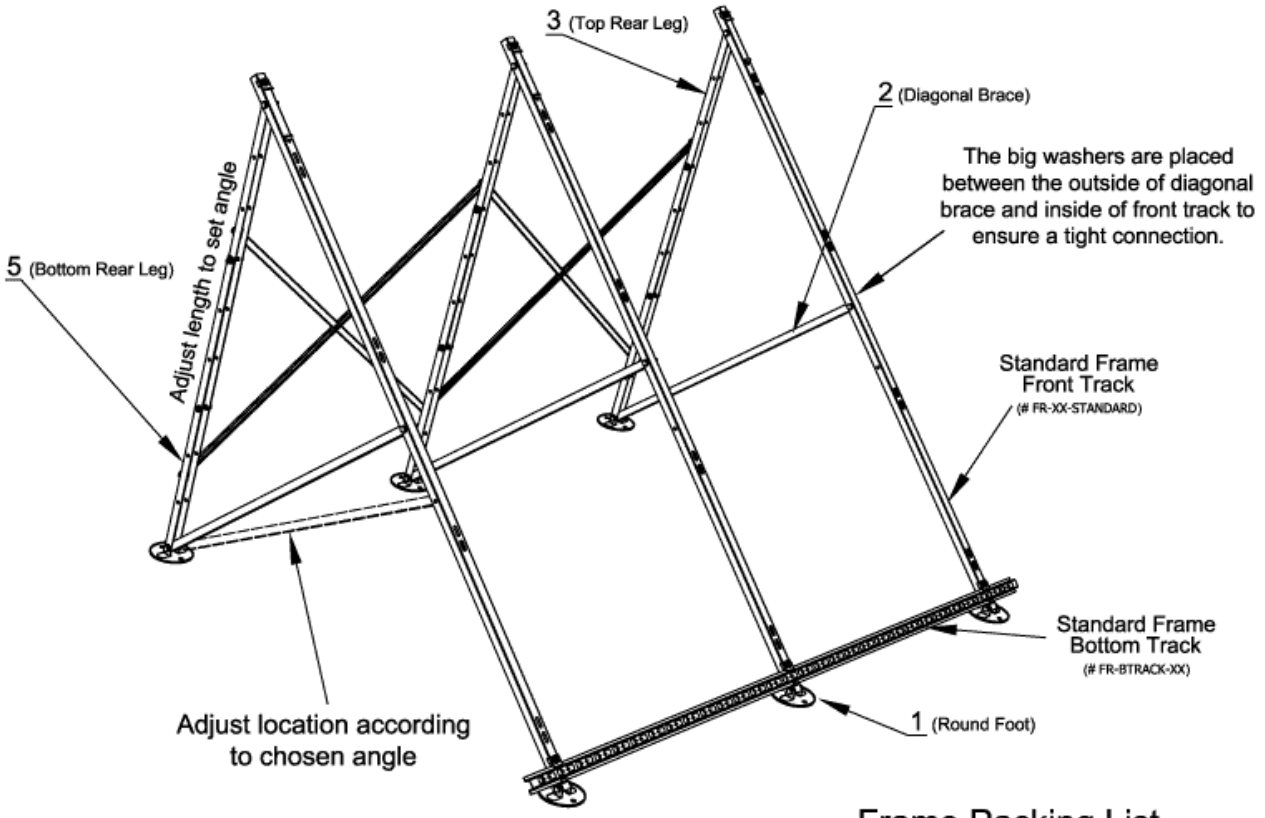
Part #	Component Quantities			
	10 & 20 Tube		22 & 30 Tube	
	FEET	R.TRACK	FEET	R.TRACK
1. FR-FCON	4		6	
2. FR-RCON	4		6	
3. FR-RTRACK	-	2	-	3
4. FR-TRLEG	2		3	
5. FR-RXB-MID-XX	2		4	
6. FR-RFOOT	4	-	6	-
7. FR-BOLT-M8x50	*4*	*10*	*9*	*15*
8. FR-BOLT-M8x40	-	-	*2*	*2*
9. FR-BOLT-M8x20	*5*	*5*	*6*	*6*
10. FR-NUT-M8	*17*	*25*	*26*	*38*
11. FR-WASH-S	*17*	*25*	*26*	*38*
12. FR-WASH-B	*8*	*4*	*12*	*6*
13. FR-NLOCK	*5*	*5*	*8*	*8*
14. FR-SPAN-12/14	1			

Appendix D

Apricus Solar Collector High Angle Frame Kit

Part #: FR-XX-HIGH

The components contained in this package combine with the standard frame to form the complete frame assembly shown below.



Frame Packing List

Part #	Component Quantities	
	10 & 20 Tube	22 & 30 Tube
1. FR-RFOOT	4	6
2. FR-DBRACE	2	3
3. FR-TRLEG	2	3
4. FR-RXB-HIGH-XX	2	4
5. FR-BRLEG	2	3
6. FR-BOLT-M8x50	*6*	*9*
7. FR-BOLT-M8x40	*6*	*11*
8. FR-BOLT-M8x20	*5*	*6*
9. FR-NUT-M8	*23*	*35*
10. FR-WASH-S	*29*	*44*
11. FR-WASH-B	*8*	*12*
12. FR-NLOCK	*5*	*8*
13. FR-SPAN-12/14	1	

Nuts and bolts are already attached to the appropriate components

SAFETY CONSIDERATIONS

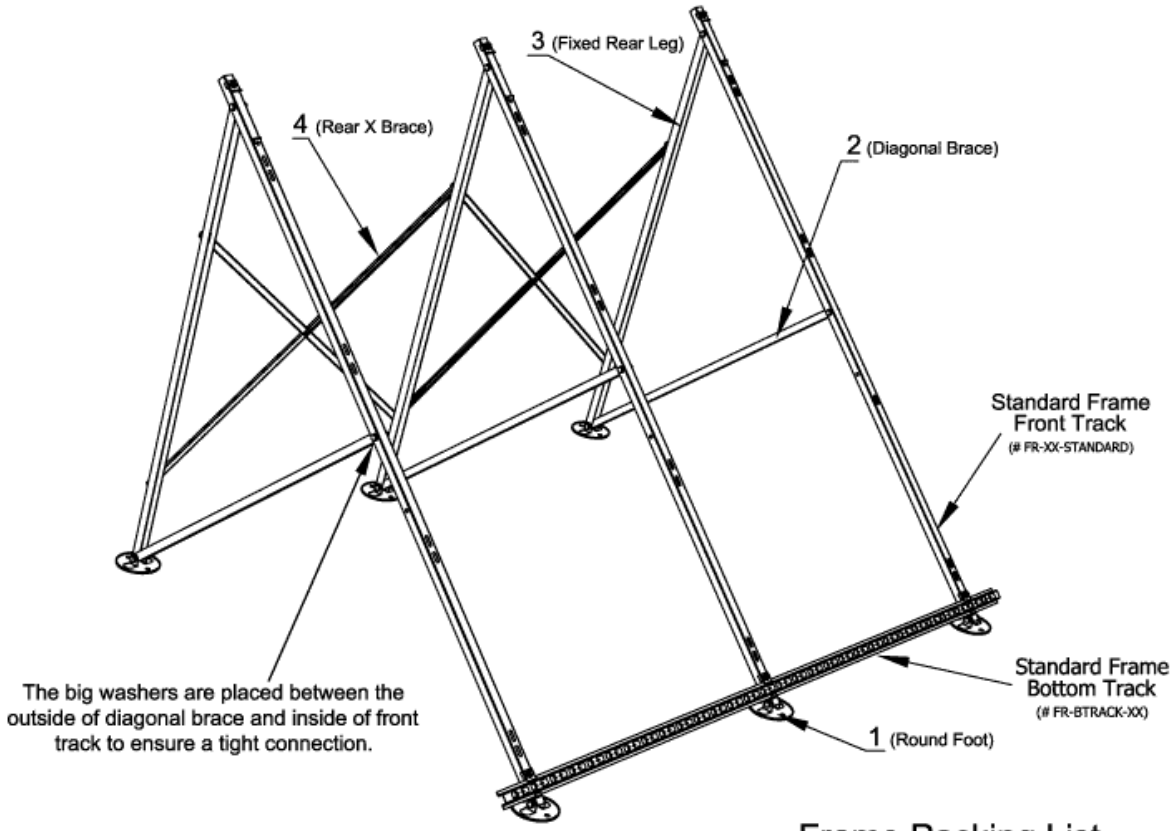
- Wear gloves when handling frame components
- Feet must be bolted to ground
- Ensure attachment points are structurally sound
- Follow relevant safety regulations regarding working on roofs

Appendix E

Apricus Solar Collector Fixed Angle Frame Kit

Part #: FR-XX-FIXED-AA

The components contained in this package combine with the standard frame to form the complete fixed angle frame shown below.



Frame Packing List

Part #	Component Quantities	
	10 & 20 Tube	22 & 30 Tube
1. FR-RFOOT	4	6
2. FR-DBRACE	2	3
3. FR-FRLEG-XX	2	3
4. FR-RXB-HIGH-XX	2	4
5. FR-BOLT-M8x50	*6*	*9*
6. FR-BOLT-M8x40	*2*	*5*
7. FR-BOLT-M8x20	*5*	*6*
8. FR-NUT-M8	*19*	*29*
9. FR-WASH-B	*8*	*12*
10. FR-WASH-S	*21*	*32*
11. FR-NLOCK	*5*	*8*
12. FR-SPAN-12/14	*1*	*1*

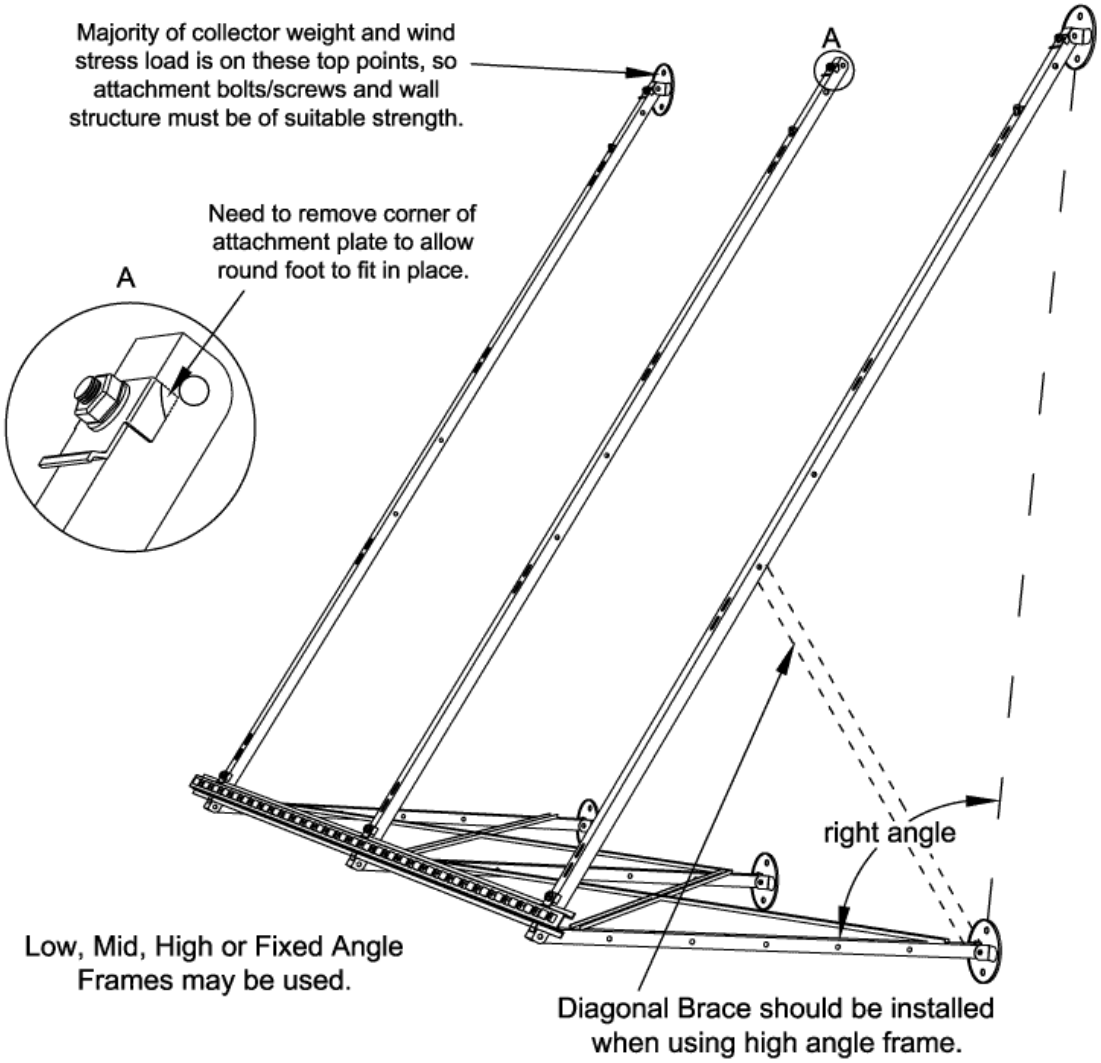
Nuts and bolts are already attached to the appropriate components

SAFETY CONSIDERATIONS

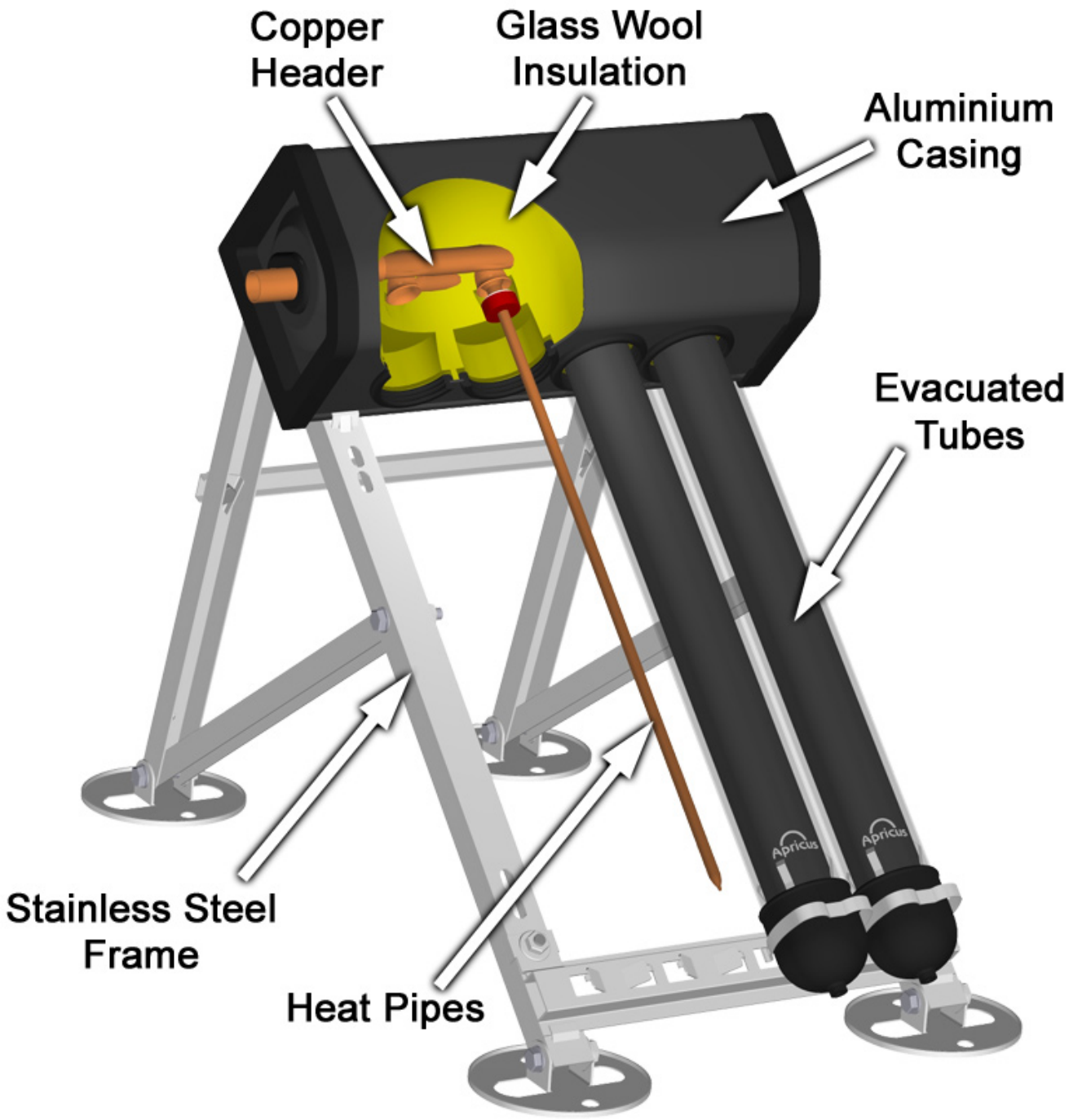
- Wear gloves when handling frame components
- Feet must be bolted to ground
- Ensure attachment points are structurally sound
- Follow relevant safety regulations regarding working on roofs

Appendix F

Apricus Solar Collector Wall Mounting Diagram



Appendix G



The above picture is a miniature version of the full size solar collector, designed to give a clear representation of the key collector components. Collector design and colour may differ from that shown above.

Appendix H

Customer Installation Record Form

Thank you for choosing Apricus. The following form should be completed by the Installation Officer for you to keep as a record of the installation in case of a warranty claim. After reading the important notes at the bottom of this page, please also sign this document.

Customer's Name:	
Address of Installation:	
Date of Product Installation:	
Installer's Code:	
Product Serial Number(s):	
Comments:	
Installer's Phone Number:[1]	
Signed by Installation Officer:	
Signed by Customer:[2]	

IMPORTANT NOTES:

1. Please only sign if you are happy with the service provided by the Installation Officer and the system is working properly. If you are not satisfied please call the contact number listed below.

2. In the case that the system has any problems, please call the Installation Officer. If you are unable to make contact, or are unhappy with the response, please contact the contact number listed below.

DISTRIBUTOR/DEALER PLEASE INSERT CONTACT DETAILS.