November 2015

Apricus®
SOLAR HOT WATER

ETC SOLAR COLLECTOR

Installation & Operation Manual

(North America)

Contents

1. Important Information

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

1.1. Scope of Manual

a) This manual pertains only to the installation and operation of the Apricus ETC evacuated tube solar collector. Details for the installation, operation and maintenance of the additional solar system components should be provided separately by their respective manufacturers.

1.2. Local Standards

a) 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) 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.

c) Unless otherwise specified in section 9, no part of the Apricus solar collector may be inspected, repaired or maintained by anybody other than an authorized person(s).

1.4. Component Materials

Component	Material Specifications
Evacuated Tubes	**Material:** Borosilicate 3.3 **Tube Style:** Twin wall all glass **Dimensions:** ⌀2.28" outer tube; ⌀1.85" inner tube; 71" length, 0.07" outer tube wall thickness **Absorber Material:** Selective coating **Absorptance:** >92% (AM1.5); **Emittance:** <8% (176°F) **Vacuum:** P<5x10^{-3} Pa; **Heat Loss:** <0.14 Btu/hr/ft^2/°F
Heat Pipes	**Material:** High purity "oxygen free" copper (ASTM: C10200) **Working Fluid:** Non-toxic liquid (Apricus' proprietary mixture) **Maximum Heat Transfer Capacity:** 750 Btuh **Operating Angle:** 20-80° **Startup Temperature:** ~86°F
Copper Header Pipe	**Material:** Copper (ASTM: C1100); **Brazing Rod Material:** 45% Silver (BAg45CuZn, NSF 61 potable water tested) **Maximum Pressure:** 116 psi **Connection Options:** 3/4"M NPT; 3/4" SWEAT (7/8" OD US Copper Pipe);
Heat Transfer Fins	**Material:** High purity aluminum
Rubber Components	**Material:** HTV Silicone Rubber (UV stabilized)
Mounting Frame	**Material:** 6005-T5 Aluminum Alloy with Anodized Finish (SS available upon request)
Tube Clips	**Material:** 316 Stainless Steel
Fasteners	**Material:** 316 Stainless Steel
Manifold Casing	**Material:** 3003 Aluminium with PVDF coating.
Manifold Insulation	**Material:** Glass Wool (0.058 Btu/hr.ft.°F) **Thickness:** Average >2"

1.5. Collector Specifications

Not all models listed below are available in all markets.

ETC-10

Dimensions (LxWxH) *	78.9” x 31.3” x 5.35”
Category C High Rating**	14.8 kBtu/day
Aperture Area	10.26 ft^2
Gross Area	17.13 ft^2
Gross Dry Weight	77 lbs
Fluid Capacity	0.08 gal
Flow Rate	0.2 gpm (max 4gpm)

ETC-20

Dimensions (LxWxH) *	78.9” x 58.9” x 5.35”
Category C High Rating**	27.9 kBtu/day
Aperture Area	20.52 ft^2
Gross Area	32.3 ft^2
Gross Dry Weight	141 lbs
Fluid Capacity	0.14 gal
Flow Rate	0.33 gpm (max 4 gpm)

ETC-30

Dimensions (LxWxH) *	78.9” x 86.4” x 5.35”
Category C High Rating**	40.9 kBtu/day
Aperture Area	30.77 ft^2
Gross Area	47.33 ft^2
Gross Dry Weight	209 lbs
Fluid Capacity	0.2 gal
Flow Rate	0.5 gpm (max 4 gpm)

An ARRA compliant Made in the USA version of the 30 tube collector (ETC-30C), is available for government funded commercial projects.

All Models

Installation Angle	20 ~ 80°
Stagnation Temperature	442°F
Max Operating Pressure	116 psi

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) When possible ship boxes standing upright. 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 a silver colour. 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.
b) Heat pipes are bright and shiny copper colour when newly manufactured, but will dull and may form dark-grey surface discolouration over time. This is due to mild surface oxidation (when exposed to air), which is normal and does not affect the integrity of the heat pipe.
c) Do not remove and/or expose the evacuated 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.
d) 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 frame components. Refer to the packing lists and diagrams included with each set of components for clarity on how to assemble.
b) Depending on the roof surface, stanchions, flashings, 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

a) System design should be completed prior to commencing installation.

b) Solar collectors need to be installed correctly to ensure high efficiency, and most importantly, safe and reliable operation.

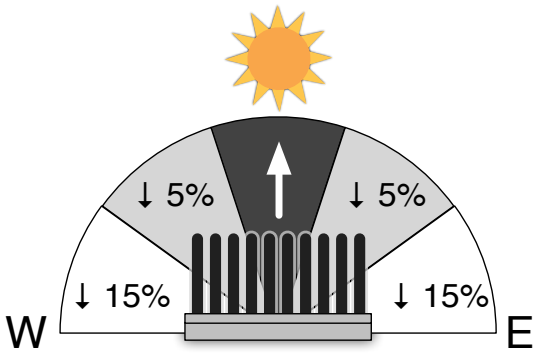
c) Seek professional advice for the design and installation of the solar heating system.

d) Apricus warranty policy excludes failures caused by improper system design.

3.2. Collector Direction

a) The collector should face due South.

b) The collector will work if facing East or West of South but a reduction in output will result (depending on location and system configuration). The diagram to the right provides a rough guide of the reduction in output that can be expected.

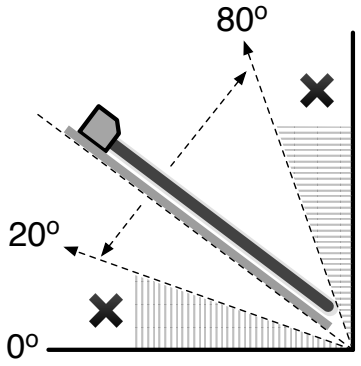


3.3. Installation Angle

a) For optimal annual solar output, install the collector at an angle equal to the location's latitude. An angle of +/- 10º 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 15-20º greater than the latitude of the location which will help reduce summer output and maximise winter output.
E.g. Latitude of 30º, install at 45-50º.

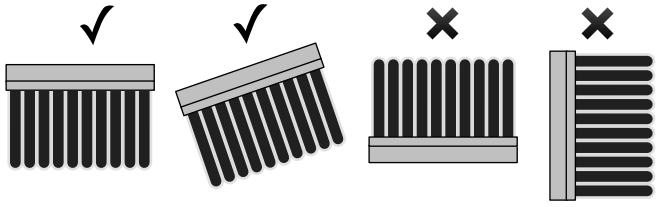
c) The collector must be installed within the range of 20-80º to ensure optimal operation of the heat pipes.



3.4. Collector Orientation

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 an E-W sloped roof (e.g. "sawtooth" mounting).

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 between 9am - 3pm.

b) Partial shading, due to small objects such antennas and small flues/chimney, will not significantly reduce heat output.

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 points of use in the building.

3.7. Heat Transfer Fluids

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

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

i)	Total dissolved solids	< 600 p.p.m.
ii)	Total hardness	< 200 p.p.m.
iii)	Chloride	< 250 p.p.m.
iv)	Free Chlorine	< 5 p.p.m
v)	Magnesium	< 10 p.p.m.
vi)	Sodium	< 150 p.p.m
vii)	Electrical conductivity	< 850 µS/cm
viii)	pH	6.5 - 8.5

c) When a direct flow system is used in an area with hard water (high mineral content), scale may gradually form in the solar collector loop causing the following issues:

i) Gradual reduction in performance
ii) Increased pressure drop
iii) Eventual blockage (no flow)

d) In regions with hard water a water treatment system should be installed, which either removes the scale forming minerals, or prevents formation of scale.

e) In regions where freeze protection is required, it is advisable to use a closed loop system with a non-toxic grade heat transfer liquid, propylene glycol or acceptable substitute. This liquid should be used directly (if already mixed), or mixed with purified and inhibited water as per the manufacturer's instructions. Apricus recommends heat transfer liquids based on Susterra glycol from DuPont which has good performance and stability when used in solar thermal systems.

f) Maximum allowed concentration of heat transfer liquids is 50% mixed with water.

g) Periodic inspection of the heat transfer fluid should be completed (annually), and replaced if necessary to ensure that the liquid meets the requirements outlined in (b) above. Please refer to the guidelines provided by the heat transfer fluid manufacturer regarding fluid inspection and replacement.

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

3.8. Solar Controller Settings

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

i) Delta-T ON = 15°F
ii) Delta-T OFF = 4°F
iii) Delta-T TARGET (for variable speed pump control) = 15°F

b) These settings may need to be altered slightly according to the location, system design and pipe run distance.

c) Refer to the controller installation manual for more information.

3.9. Correct System Sizing

a) The solar collector should normally be sized to provide 90-95% of hot water requirements during summer period.

b) Depending on the location this will provide 60-80% annual contribution to domestic hot water supply.

c) Trying to achieve very high annual contribution will result in an oversized system that will waste excess heat.

3.10. Stagnation and Overheating

a) Stagnation refers to the condition that occurs when the pump stops running as a result of normal system shutdown once the storage tank has reached the desired maximum temperature, or due to pump failure, power blackout, etc.

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 >400°F; therefore components that may be exposed to the high temperatures such as valves, plumbing or insulation, should be suitably temperature rated.

c) Temperature/Pressure relief valves MUST NOT be installed in close proximity to the solar collector as they will open

each time the collector stagnates, causing failure due to loss of heat transfer fluid.

d) Air vents may be used during system commissioning, but must be removed before normal operation.

e) In direct flow systems, 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 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.

f) In a closed system, dumping of any liquid from the pressure and temperature relief valve is an indication of an undersized expansion tank, or incorrect expansion tank and/or system pressure settings.

g) Expansion tank capacity should be increased by 1/4 gallon per 30-tube collector included in the system, and additional volume may be required for fluid volume in piping held above the lowest collector in the system.

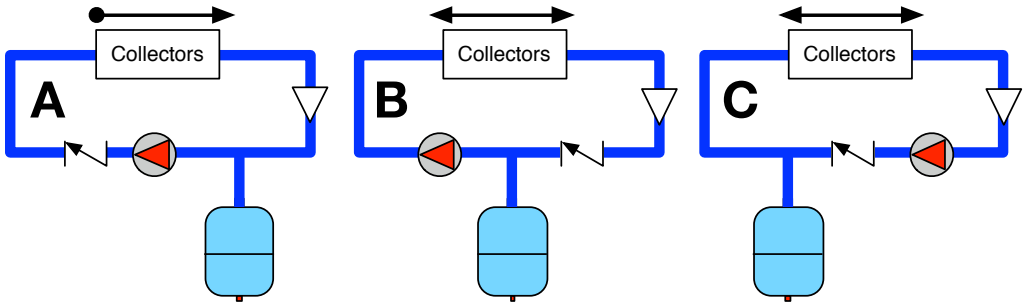
h) To allow the system to stagnate and form steam without over-pressurisation or hot (return) line heat migration issues, installation of a suitably sized expansion tank AFTER the check valve on the cold (supply) line is recommended. This format is commonly referred to as “steam back” and allows steam to form in a even, controlled way in the solar collectors. Apricus ETC solar collectors are designed for steam back operation. Commercial systems with complicated piping layouts may not allow steam back to occur properly, please consult with Apricus for system design assistance.

i) The diagrams below show the various configurations for expansion tank, pump and check valve position:

   i) Option A = WORST. Expansion tank on inlet side of pump, before check valve. Solar expansion only in one direction, NOT steam back compatible.

   ii) Option B = BEST. Expansion tank between pump and check valve. Steam expansion able to occur in both directions (steam back). Expansion tank on pump inlet side provides optimal pump head pressure.

   iii) Option C = OK. Expansion tank after pump and check valve. Steam expansion able to occur in both directions (steam back), Not suitable for low pressure (<30psi) systems or when >30 foot high pump head is required. This is because the position of the expansion tank after the pump drops inlet pressure to pump by pump head value which can fall under pump NPSH requirements causing cavitation.



3.11. Pressure and Temperature Control and Relief

a) For direct flow systems, the normal operating pressure should be limited to <70psi via use of a pressure limiting (pressure reduction) valve on the mains cold supply line.

b) For closed loop systems that have 75psi (or greater) pressure relief valve, the recommended system pressure setting is 40 psi filling pressure, with expansion tank sized to allow maximum pressure of 60psi during stagnation. Use the Apricus toolkit to help correctly size the expansion tank.

c) Any system design must provide pressure relief at no more than 120psi, 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.

d) Pressure & Temperature relief valves must not be located in close proximity to the solar collector field.

e) If installed inside a building the pressure and temperature relief valve should expel to suitable drain or storage vessel.

3.12. 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 20°F, the "Freeze Protection" special function on the Solar Controller may be used. (i.e. Pump circulates if the manifold temperature approaches freezing). If required, 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 20°F, there are two main freeze protection options:

   i) A closed loop filled with a Propylene Glycol mix can be used to provide freeze protection. Please refer to the fluid manufacturer's specifications for recommended concentrations in the system temperature range. See also 1.4 regarding water quality requirements. Heat transfer liquids are required to be Generally Regarded as Safe (GRAS); please check with local regulations.

   ii) Drain back systems allows the solar collector to drain empty of water each time the pump stops circulating. A drain back tank is required and system piping must be sloped sufficiently to allow proper drainage.

c) In any system that may be exposed to temperature close to freezing, insulation of at least 1" thickness must be used on all exposed outdoor piping. (ref. section 5.6)

d) 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.

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

3.13. Wind Loading

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

b) The standard frame and angle frame kits are designed to withstand wind speeds of up to 130 mph without damage for installation angles of 45° or less. This wind speed corresponds to the mid range of Category 2 cyclones (US Saffir-Simpson Scale).

c) Roof strength and any non Apricus supplied attachment components must be reviewed and approved by structural engineer.

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

3.14. Snow Load

a) In areas prone to heavy snow falls, it is recommended that the solar collectors be installed at an angle of 50° or greater to help snow fall or blow off the tubes.

b) It is advisable to raise the front of the collector frame 6-8" off the roof surface to allows snow to sit beneath the collector and also more easily blow away from under the collector. To achieve this use longer stanchion/poles for roof mounting, or use the Apricus Leg Extension (EARL-EXT) components offered by Apricus.

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

3.15. Hail Resistance

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

b) In areas prone to large hail (>1") 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 authorized persons only. Please refer to section 9.3 for more details on tube replacement.

3.16. Lightning

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

4. Collector Mounting

⚠ WARNING

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

4.1. Frame Material

a) Apricus ETC collectors are supplied as standard with high strength, corrosion resistant frames made from anodised aluminium alloy with marine grade 316 stainless steel fasteners (attachment plates, nuts, bolts and washers).

4.2. Roof Attachment Strength

a) Frame attachment to the roof should be completed with ø5/16" or larger screws or stainless steel bolts.

b) Ensure the mounting surface or ballast is solid and able to withstand in excess of 1000 lbs of pull force that each 30 tube collector may encounter during high winds.

c) Refer to the Apricus toolkit for wind loading estimates.

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

4.4. Installation Planning

a) Measure the roof and 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) 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.

4.5. 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 finger tighten nuts until attachment to the roof is complete, then tighten all bolts with hand socket wrench. 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.

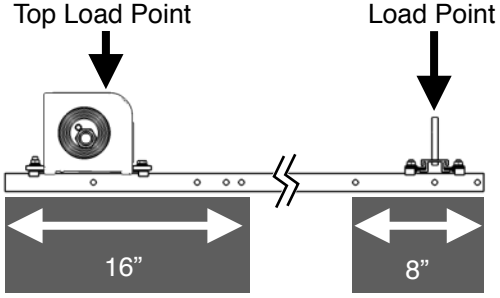
4.6. Frame Attachment Points

a) Any attachment point (stanchion, post, roof rail etc) underneath the Front Track must be within a limited distance of the top and bottom load points to avoid excessive bending forces on the frame components.

b) The support range is:

i) 8" from the bottom end of the front track

ii) 16" from the top end of the front track

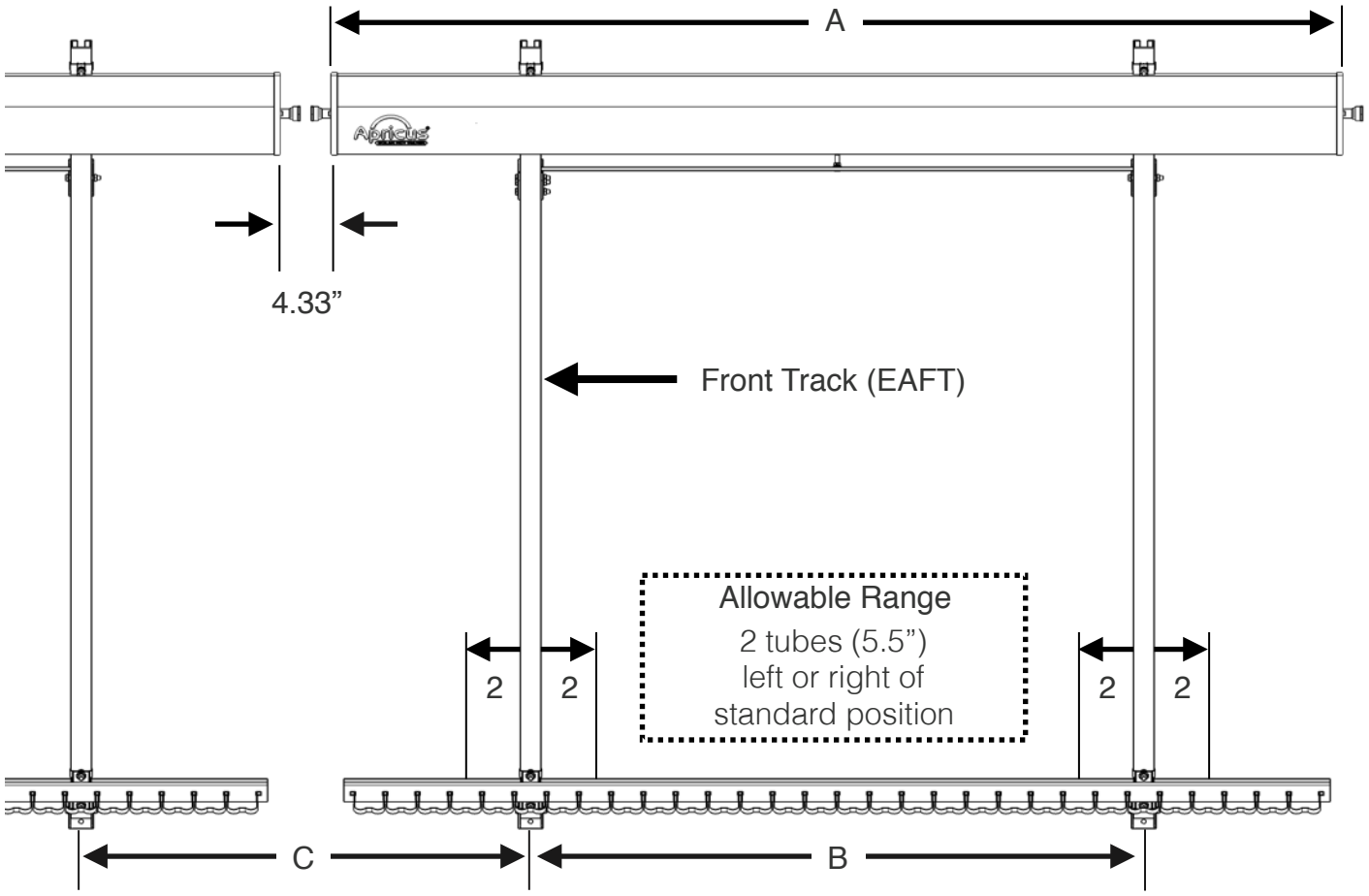


4.7. Frame Front Track & Leg Spacing

a) The Front Tracks can be adjusted left and right underneath the manifold and bottom track to select a suitable location within the allowing range of 2 tubes (5.5") either side of the standard positions. The standard frame spacing (B), locates the Front Tracks directly underneath the evacuated tubes.

b) For angled frames the X Brace (EAXB- XX T) attached to the Rear Legs sets the standard position of the Front Tracks and Rear Legs.

c) Spacing between 2 collector joined in series using Apricus connector (BS-FF-CC) is 4.33".

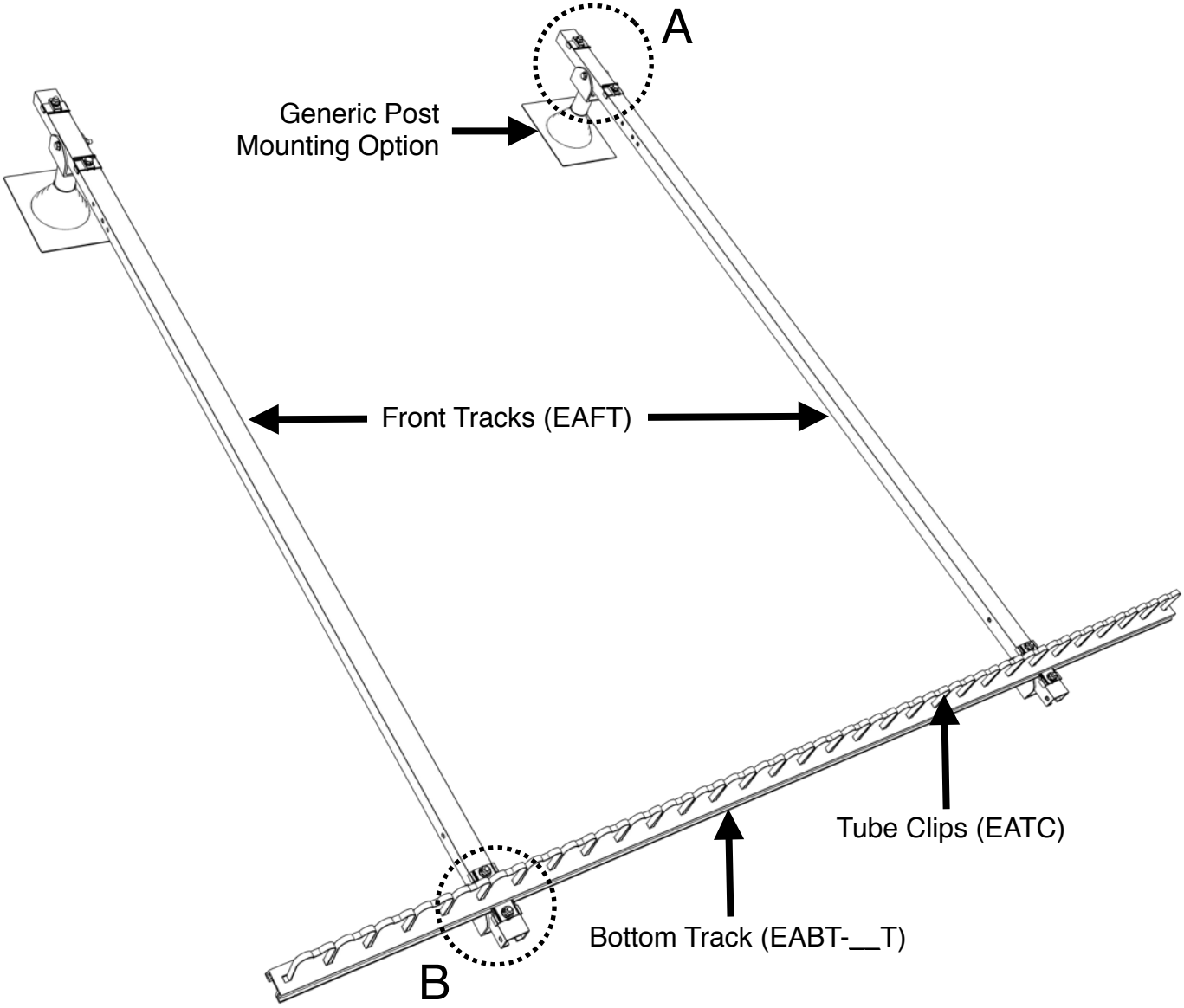


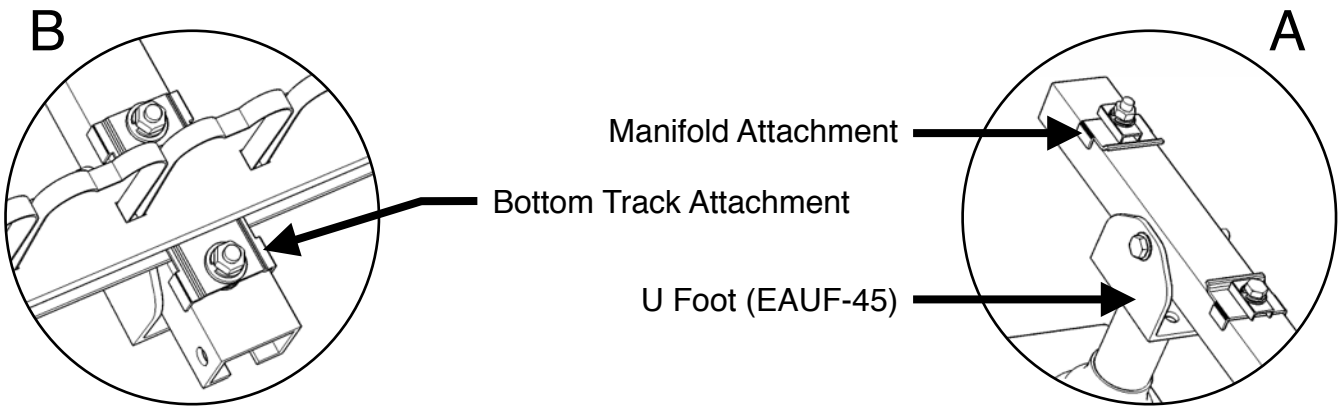
# Tubes	A (Manifold Width)	B (FT Spacing)	C (Next FT Spacing)
10	31.3"	19.3"	16.4"
20	58.9"	41.5"	21.9"
30	86.4"	52.4"	38.4"

4.8. Standard Frame Overview

a) The ETC solar collector standard frame is suitable for flush mounting on a >20° (>4:12) pitched roof.

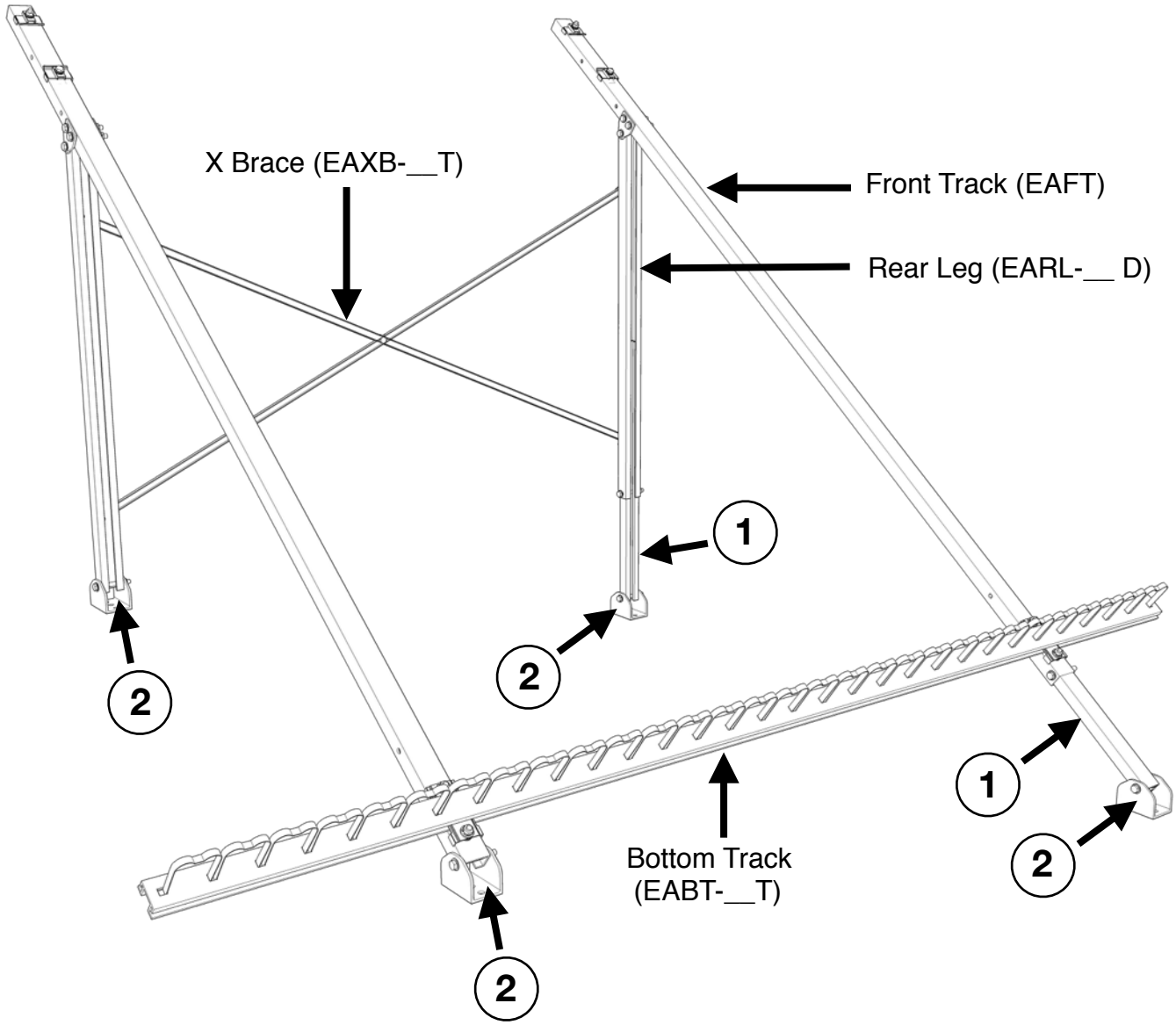
b) U feet (EAUF-45) are the standard method of attachment to the to the Front Tracks (as shown below). The U Feet may be attached to posts, stanchions or rails such as Uni-strut.





4.9. Angled Frame

a) Two Rear Legs and an X Brace are added to the Standard Frame to raise the rear of the collector.
b) 4 leg lengths are available to achieve angles from ~22º up to ~60º, with finer angle adjustment using Leg Extensions.
c) Leg Extensions can also be used to extend the Front Track to raise the front of the collector in snowy regions.



1. Leg Extension (EARL-EXT)
2. U Foot (EAUF-45)

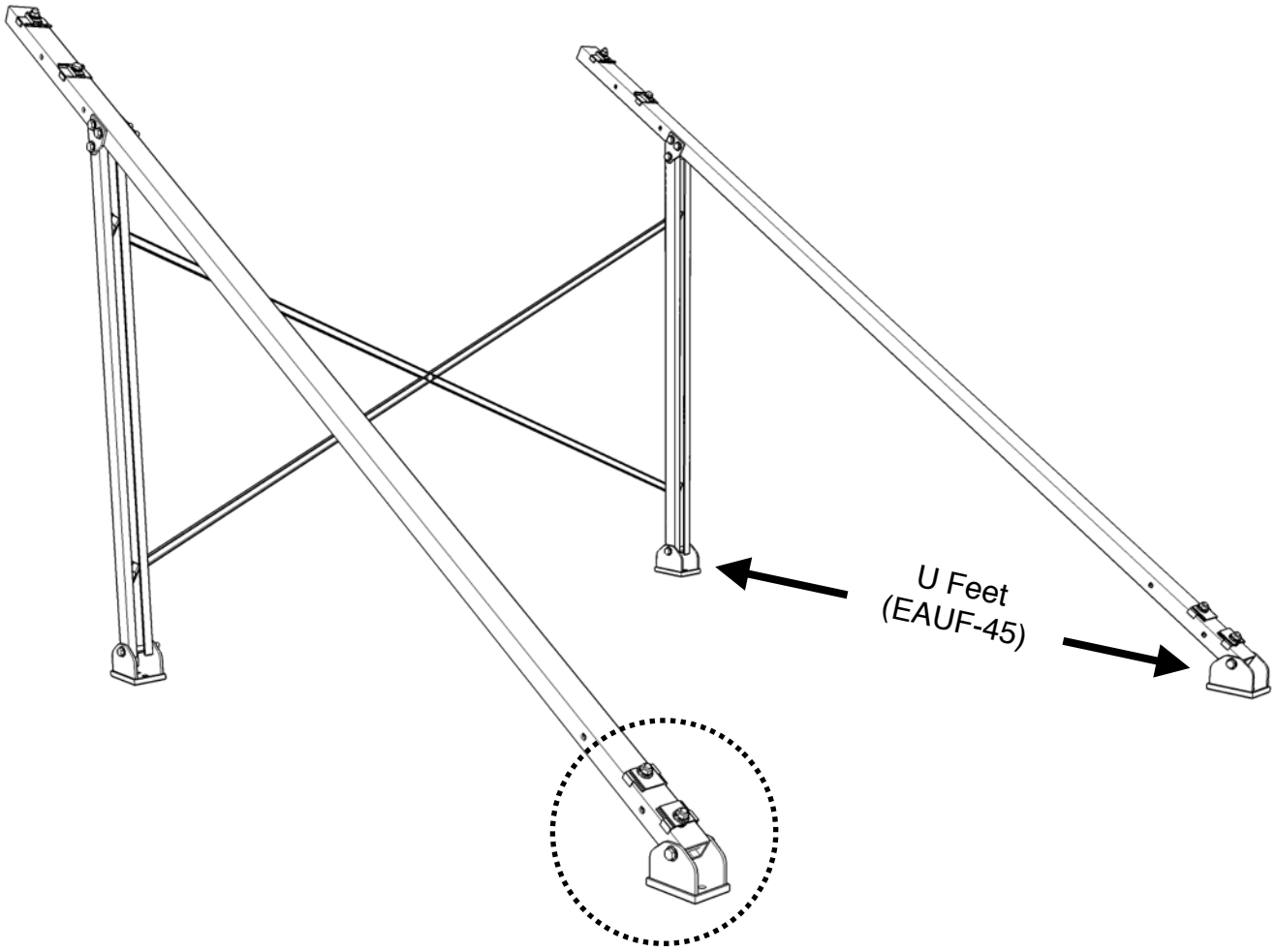
4.10. Frame Attachment Option (U Feet)

a) Ideal for flat roof mounting on concrete blocks or metal framework.

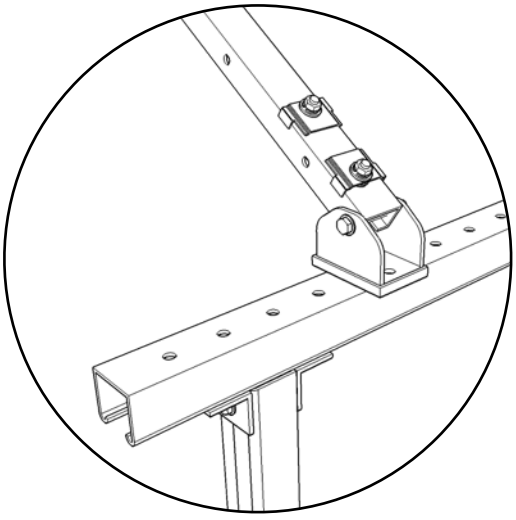
b) Normally used with angled frames (rather than standard frame flush mount).

c) Attached to the end of Rear Legs, Front tracks or Leg Extensions.

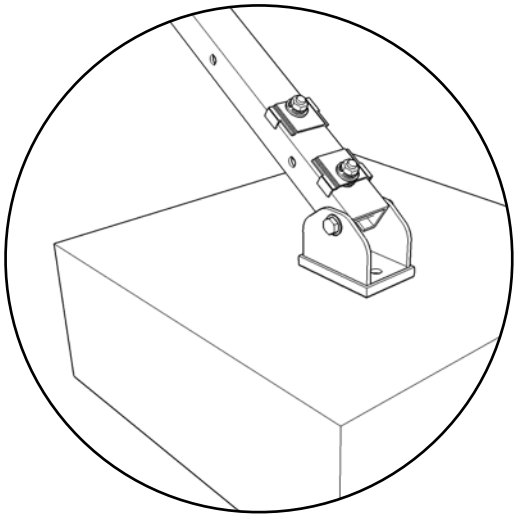
d) Include a silicone rubber cover to protect other metal surfaces and provide basic sealing.



Metal Frame

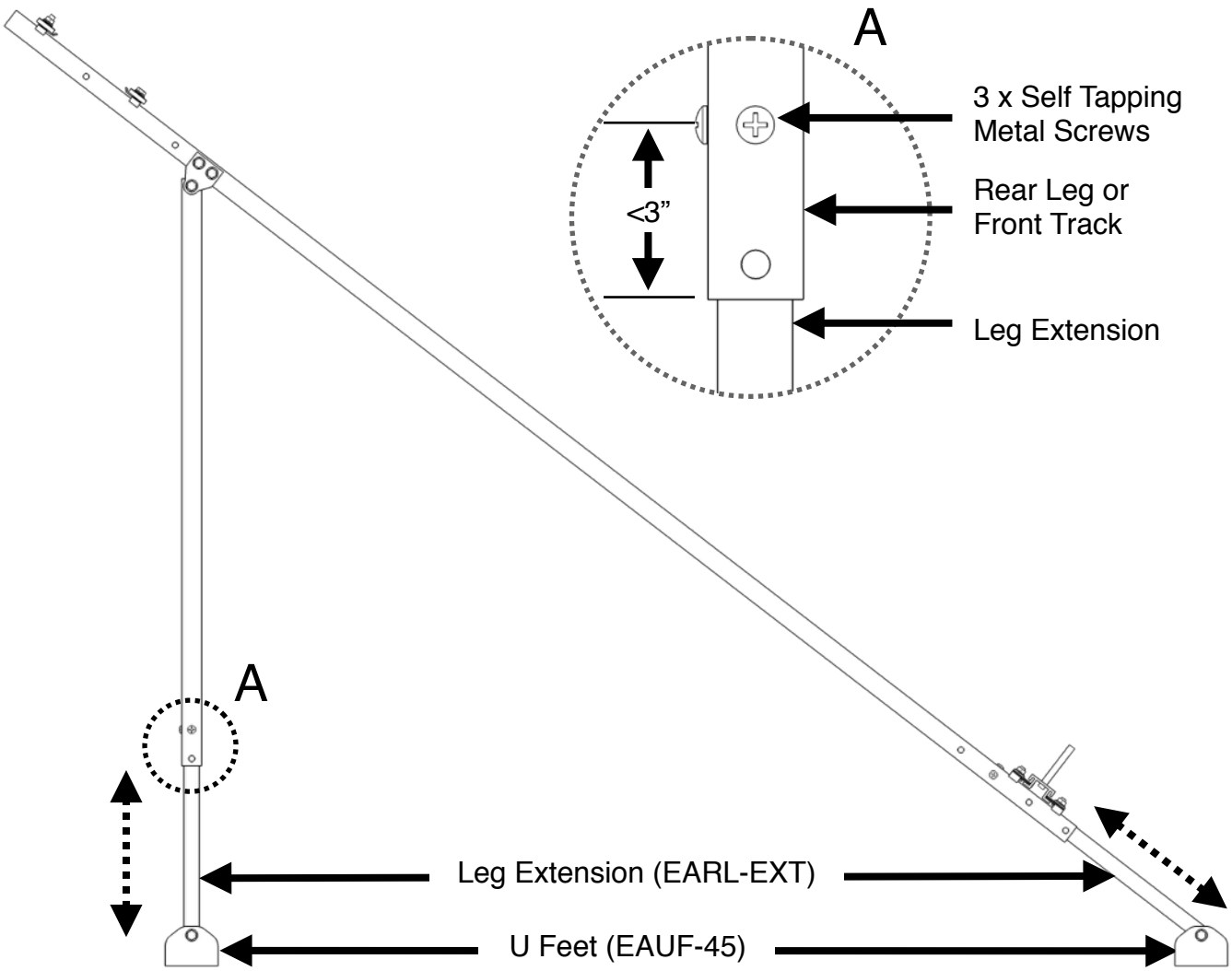


Concrete Block

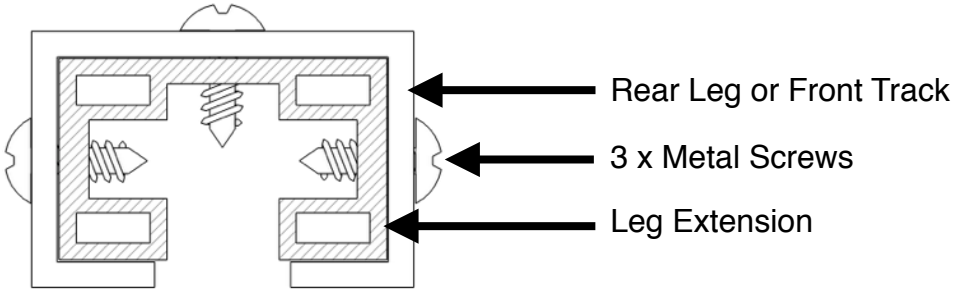


4.11. Frame Option (Leg Extensions)

a) Extend Rear Legs (RL) to achieve larger installation angle.
b) Extend Front Tracks (FT) to lift front of collector off roof in high snowfall regions.
c) Leg Extensions are NOT supplied as standard with Rear Legs and must be ordered separately.
d) Leg Extension slide inside RL or FT for flexible length adjustment.
e) Insert Leg Extensions minimum of 4” into RL or FT.
f) Secure with 3 stainless steel screw (supplied) within 3” of end of RL or FT (drill #28 pilot holes).



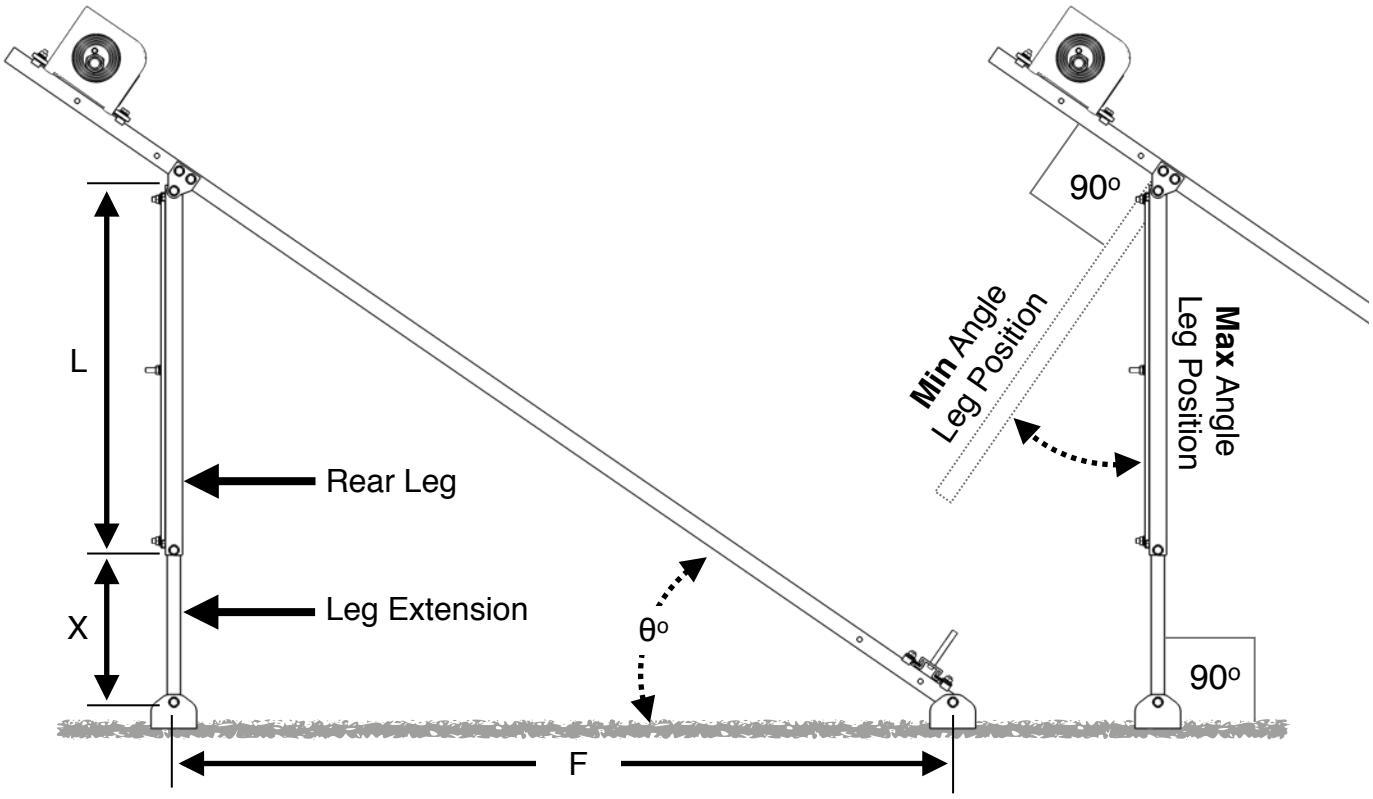
Cross Sectional View



4.13. Mounting Frame Leg Length & Feet Spacing

a) Rear Legs can be adjusted between Min & Max positions to make small adjustments to the angle.

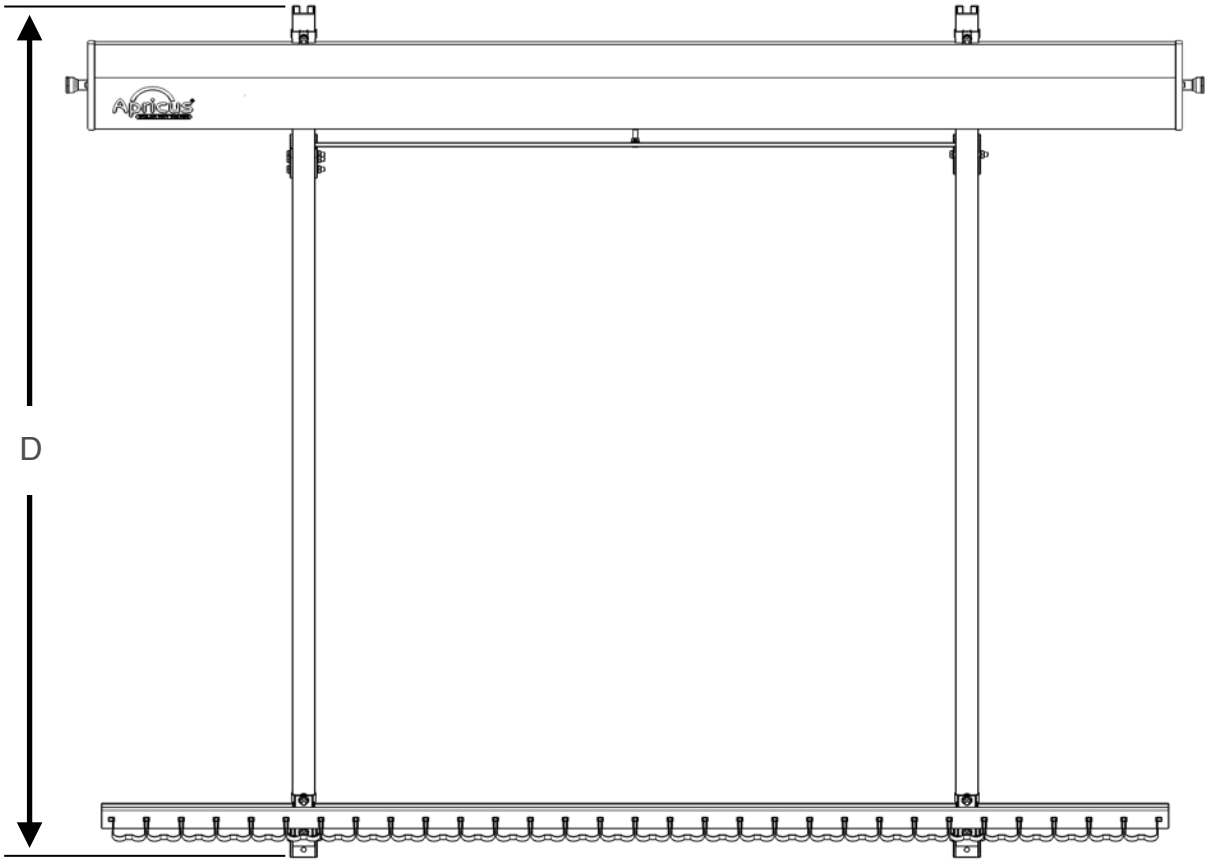
b) Leg positions outside this range are not structurally sound and must not be used.



L (Leg Length)	X (Extension)	F (Min)	F (Max)	θº (Min)	θº (Max)
EARL-20D (25.6”)	No Extension	69.7"	59.6"	22º	23º
	4"	71.3"	57.8"	25º	27.6º
	8"	73.1"	55.7"	28º	31.6º
	12"	75"	53.1"	30.5º	35.8º
	16"	77.2"	50.2"	33º	40.3º
	20"	79.5"	46.6"	35.4º	45º
EARL-30D (35”)	No Extension	73.6"	54.8"	28º	33º
	4"	75.6"	52.1"	30.5º	37º
	8"	77.8"	49"	33.1º	42º
	12"	80.1"	45.2"	35.5º	47º
	16"	82.5"	40.7"	37.8	52º
	20"	85.1"	35.3"	40º	58º
EARL-45D (46.4”)	No Extension	79.8"	45.8"	35.2º	46
	4"	75.7"	41.4"	30.5º	51.3º
	8"	77.8"	36.1"	33.1º	57.2º
EARL-60D (56.1”)	No Extension	85.8"	33.4"	50º	60º

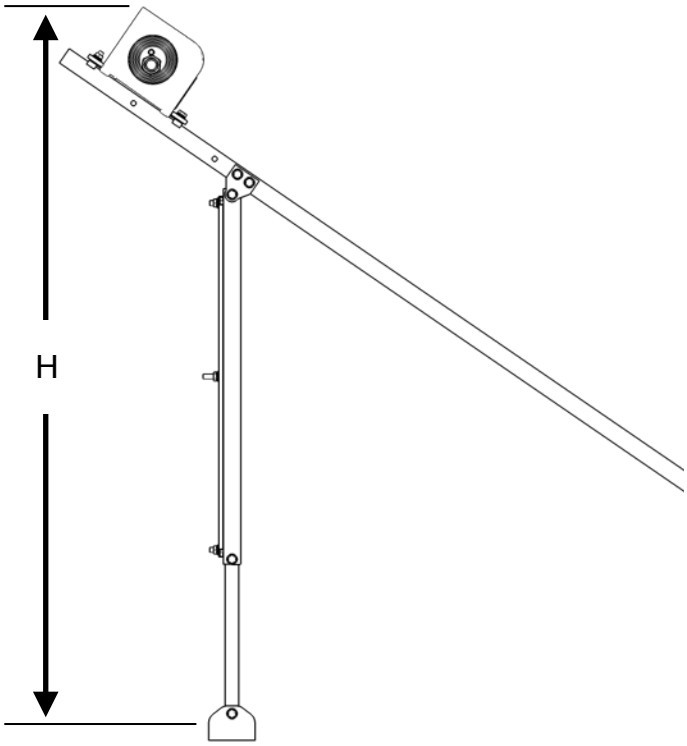
4.14. Mounting Frame (Depth & Height Dimensions)

a) The following diagram and table provides the overhead depth (D) and height (H) of the collector at each 5° incremental angle between the allowable 20-80° range.



Angle	D (Depth)	H (Height) *
20°	76.3”	31.6”
25°	73.7”	37.6”
30°	70.6”	43.3
35°	66.9”	48.7”
40°	62.7	53.7”
45°	58.1”	58.3”
50°	53”	62.4”
55°	47.6”	66.1”
60°	41.7”	69.3”
65°	35.6”	72.2”
70°	29.3”	74.7”
75°	22.6”	76.8”
80°	15.9”	78.2”

* Height does not include U foot.



4.15. Wall Mounting

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

b) Ideally use short Rear Legs (EARL-20D) attached to the bottom of the front tracks rather than the top.

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

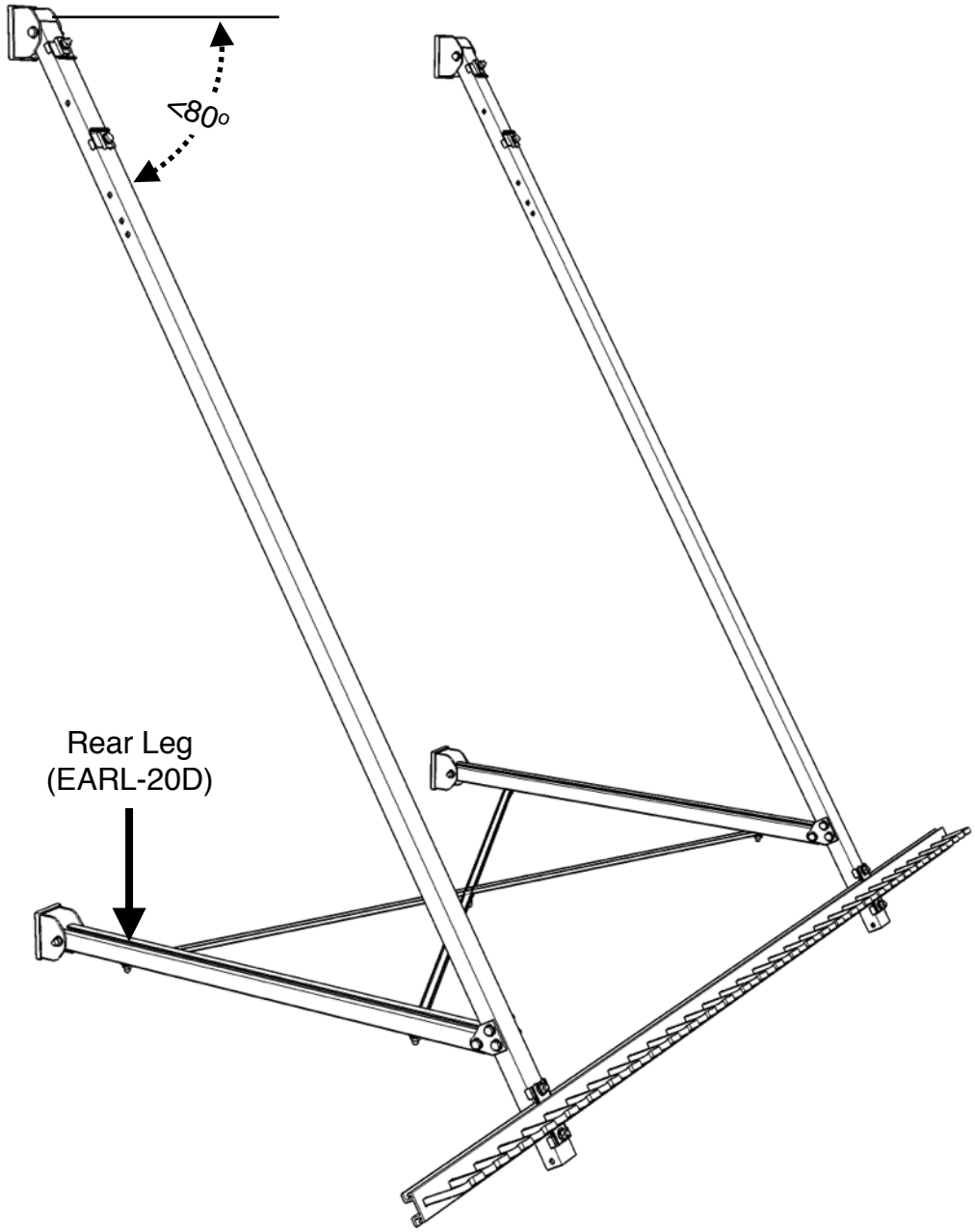
   i) For brick or concrete walls use expansion bolts.

   ii) For wood or metal framing use screws or bolts 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. (ref. section 3.13)

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.



4.16. Manifold Attachment

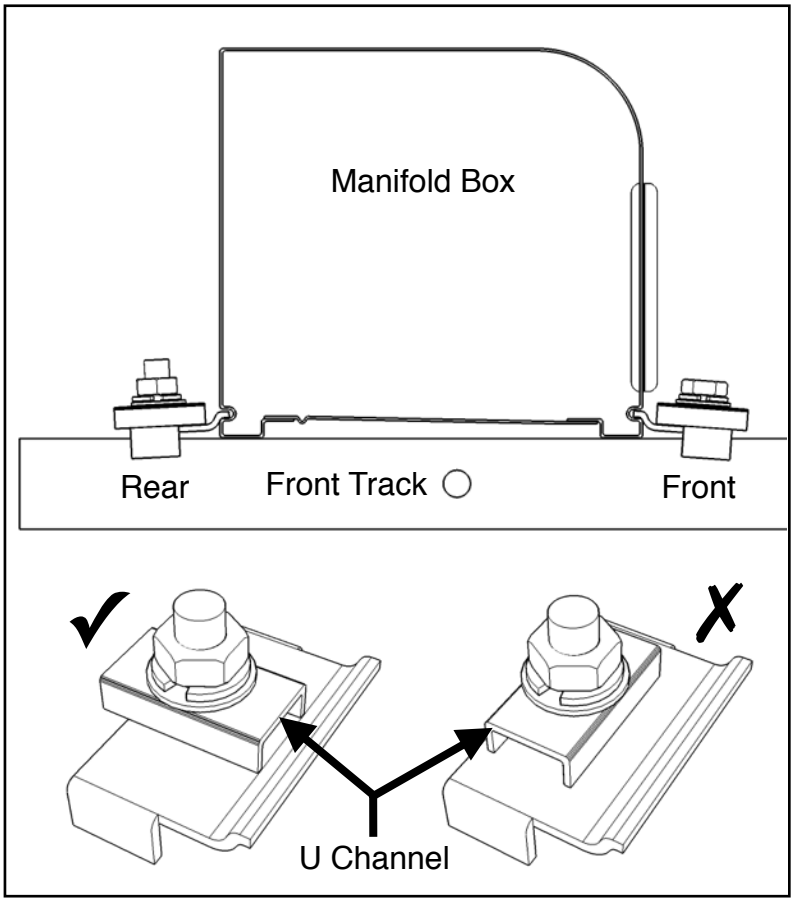
a) The manifold is secured to the frame front tracks using special attachment plates that lock into grooves along the front and rear of the manifold casing.

b) Attachment plates are already attached to the front tracks, so only need to be loosened slightly to allow the manifold and bottom track to be fitted. There is no need to completely remove them.

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

d) Attachment steps:

1. Loosen the front and rear attachment plates enough for the manifold to drop into position.
2. Slide the manifold left and right to correct position and align with the bottom track.
3. Push the manifold down and finger tighten the front attachment plate bolts, ensuring the attachment plates are full depth into the manifold casing groove.
4. Push the rear attachment plate down firmly into the groove at the rear of the manifold casing and finger tighten the nut.
5. Tighten both attachment plates, ensuring the U channel on top is in the correct position.

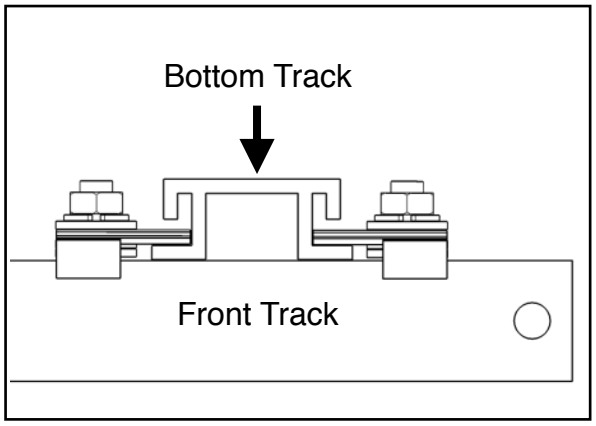


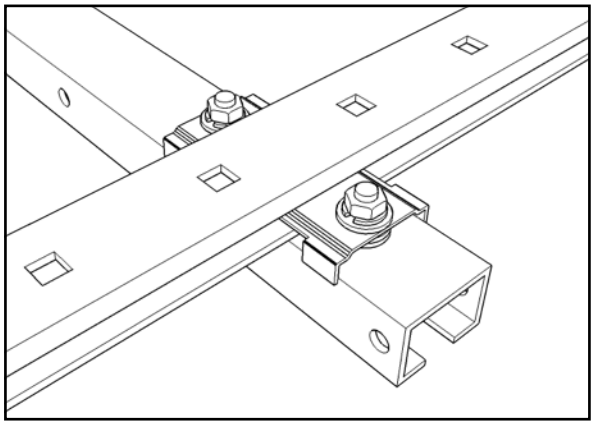
4.17. Bottom Track Attachment

a) The bottom track is secured using attachment plates that slot into the side of the bottom track.

b) Attachment plates are already attached to the front tracks, so only need to be loosened slightly to allow the bottom track to be fitted. There is no need to completely remove them.

c) Slide the bottom track into place between the two attachment plates. Push down and finger tighten the bottom attachment plate first. Push the top attachment plate down and then tighten both fully.





5. Piping Connection

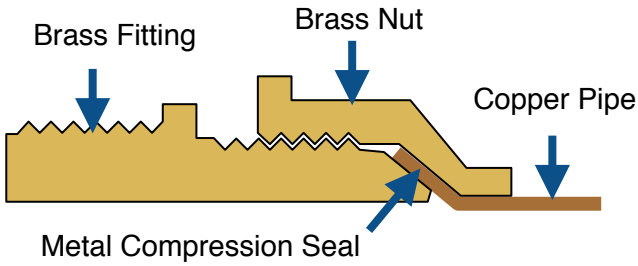
5.1. Collector Connection to Plumbing

a) The inlet and outlet of the ETC collector header pipe are factory fitted with a brass flared pipe nut. This connection forms a metal-metal-metal seal which is far more reliable than o-rings or washers when considering the high temperatures that the solar collectors experience during operation.

b) A small amount of >400°F rated thread sealant such as Loctite 567 or Leak-tite blue should be applied to the inside and outside faces of the flared copper pipe to provide some lubrication when tightening and to ensure a good seal.

c) Silver solder that can withstand >500°F such as Stay Brite® 8 should be used for any sweat fittings within 1 vertical foot of the solar collector.

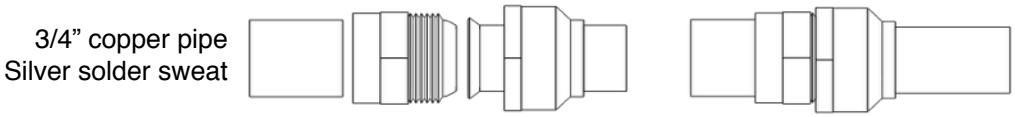
d) There are 4 types of fittings offered by Apricus collector connections in North America.



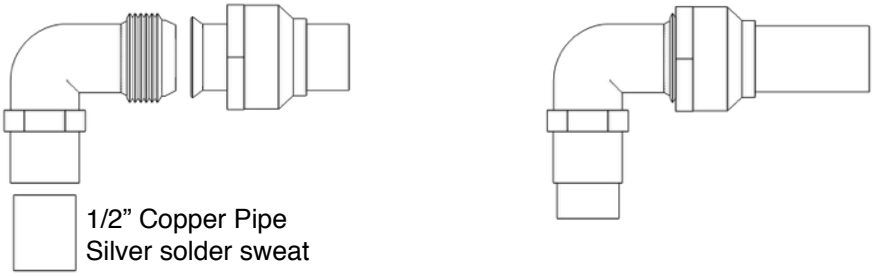
Collector-Collector Fitting (BS-FF-CC)
Used between two collectors when connected in series.

Male NPT Thread Fitting (BS-FF-075-NPT)
Provides 3/4" male NPT thread (US standard).

3/4" Copper Pipe Sweat Fitting (BS-FF-075-SWT)
Sweat connection of 3/4" copper pipe (actually 7/8" OD pipe).



1/2" Copper Pipe Sweat Elbow Fitting (BS-FF-075-SWT)
Sweat connection of 1/2" copper pipe (actually 5/8" OD pipe).
Suitable for 1/2" pipe run; Max 90 tubes (1.5 gpm)



5.2. Pipe Size and Flow Rates

a) As a general rule piping should be chosen to achieve a maximum flow speed of 3.3ft/s. Use the Apricus toolkit to help determine suitable pipe sizes.

b) Maximum total flow-rate through any collector is 4 gpm (~3.3ft/s).

c) The pipe, pump, valves and fittings on the solar line must be rated to at least 230°F.

d) Components within 2 foot vertical pipe run from the collector inlet/outlet must be rated for high temperatures of >390°F.

e) A maximum of 5 x ETC solar collectors may be connected in series with the standard Apricus straight connectors (Part BS-FF-CC). For more than 5 collectors in series a flexible connection must be used every 3 collectors.

f) As many as 10 x ETC-30T solar collectors may be connected in series as long as flexible connectors are used and maximum flow rate of 4 gpm is not exceeded, as outlined above.

g) Piping connection at each end of banks of collectors must allows movement due to expansion and contraction.

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

5.3. Flow Rate & Temperature Rise

a) Recommended flow for ETC collectors is 0.0167 gallon/tube/minute (i.e. ETC-30 flow = 0.5 gpm). This will achieve up to 27°F temperature rise in peak sunlight, and avoid excessive stop-start "short cycling" of the pump during periods of lower solar insolation.

b) Use a flow meter/setter or balancing valve to confirm the flow rate through the system.

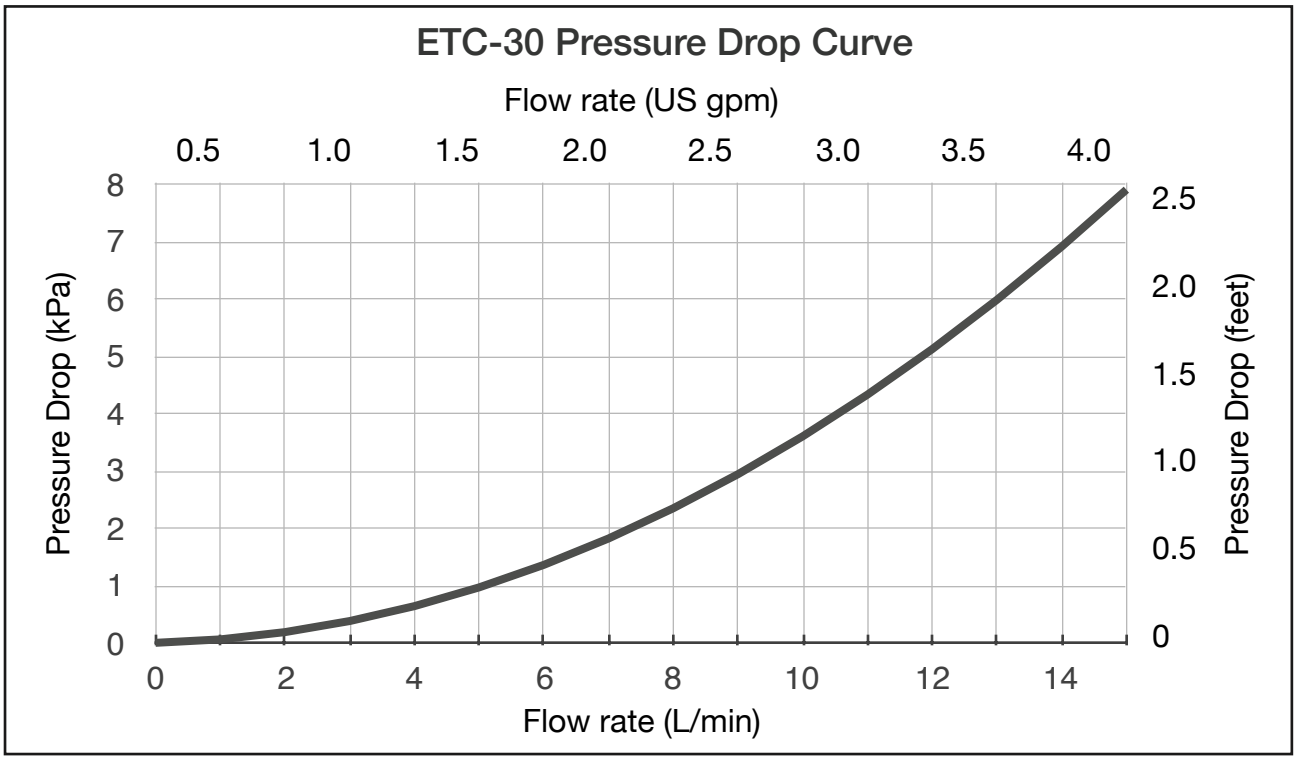
c) The following table shows the temperature rise from an ETC-30 collector at various kBtuh output levels (@0.5gpm).

	2 kBtuh	3 kBtuh	4 kBtuh	5 kBtuh	6 kBtuh	7 kBtuh
0.5 gpm	8°F	12°F	16°F	20°F	24°F	28°F

5.4. Pressure Drop Curve

a) Pressure drop through an ETC-30 tube collector with cold water for flow rates up to the maximum allowable 4 gpm is displayed in the following graph.

b) Pressure drop for other heat transfer fluids (such a propylene glycol) may be slightly higher.



5.5. Pump Selection

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

1. Flow-rate: Meet the desired flow rate for the system when the system is cold (hardest to pump), especially for system filled with a heat transfer fluid (not just plain water).
2. Head pressure: Select a pump that has sufficient head to overcome the pressure drop of the solar loop at the desired flow rate. For drain-back systems the vertical height from the drain-back tank to the collector must also be considered. Stacked pumps may be used in drain-back system to increase the total head during initial flooding, and the secondary pump can be shut off once a siphon has been established.
3. Material: For closed loop systems with corrosion-inhibited heat transfer fluid or purified water, a cast-iron body pump can be used. For direct flow systems a brass/bronze, composite (plastic) or stainless steel body pump is recommended.
4. Temperature: Must be rated to at least 230°C.

b) If using a variable speed pump, a target delta-t (T1-T2) of 15°F is recommended.

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

1. Checking for air lock in the collector or flow and return lines; repeat filling & air purge process (section 5.7).
2. Check operation of the non-return/check valve.
3. Pump operation. Pump may not be bled of air, or there may be cavitation (air bubbles forming) due to installation issues.
4. Pump may not have sufficient head pressure. If no flow in a drain-back system, head may be insufficient to provide the vertical lift required during flooding.
5. System pressure may be lower than the required minimum NPSH (Net Positive Suction Head) of the pump.

d) Always install the pump on the supply (cold line) to the collector.

e) If the system does NOT have an expansion tank located after the check valve on the supply (cold) line, then a check valve should be installed after the pump to protect from exposure to high temperatures. Some pumps may be supplied with a check valve pre-installed in the outlet port. Refer also to section 3.10 about best position for expansion tank, check valve and circulation pump.

5.6. Pipe Insulation

a) Heavily insulate all piping running to and from the manifold with a high quality insulation of at least 3/4" thickness, and >1" 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 cover, aluminum cover or similar.

c) Ensure that the insulation is water-tight and covers the inlet/outlet ports and is sealed flush against the manifold casing with silicone sealant to prevent water ingress.

d) High temperature rated insulation such as glass wool should be used on piping close to the collector (2' vertical height).

5.7. System Filling & Air Purge

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

b) Mains Pressure Direct Flow (Direct Flow):

1. An isolation valve should be installed on the return (hot) line close to the tank, with an air vent installed on the outlet of the collector as well as any high points in piping where air could be trapped.
2. Close the return line isolation/ball valve.
3. Fill the tank and open the supply line to the collector. The mains pressure water will purge the collector of air, expelling air from the air vent.
4. Turn on the circulation pump and open the isolation port. Continue to purge any remaining air from the the air vent.
5. If using an auto air vent, remove it after the air purge is complete. Manual air vents that are high temperature rated may be closed and left in place.
6. Check for correct flow rate.

c) Closed Loop (or low pressure Direct Flow):

1. The solar loop return (hot) line should be fitted with fill and drain valves with an isolation or check valve in between.

2. Open isolation valves below each air vent to allow operation. Air vents should be installed at each high point of the system. Automatic or manual air vents may be used
3. Close the isolation valve that is between the fill and drain ports.
4. Attach the fill valve to mains supply water or a manual charging station with a hose.
5. Flush the system with water for 5 minutes to clear any debris and contaminants in the pipes.
6. Close the drain valve.
7. Completely flood the system with mains pressure or charging station.
8. Open the isolation valve that is between the fill and drain valves.
9. Run the pump at maximum speed until no air is heard or felt escaping the air vent, air separator, or pump vent.
10. Turn off the pump, raise to the desired pressure then close the fill valve.
11. Monitor the pressure for at least 2 hours to ensure no leaks are present.
12. If glycol is being used, replace the water used for the pressure test with the glycol mix as follows:
    i) Connect the fill valve to the Glycol reservoir with a electric or hand pump.
    ii) Close the isolation valve between the fill and drain ports.
    iii) Open the drain valve releasing water, until the pressure is no lower than 10psi, then close it.
    iv) Charge the system back to ~40psi using the pump attached to the glycol reservoir.
    v) Repeat until glycol is seen coming-out of the drain port (typically green or blue fluid)
    vi) Close the fill valve and drain valve, and open the isolation valve.

e) For newly installed piping, a pressure test with water should be completed before finally filling occurs. Refer to local plumbing codes for pressure level and time guidelines. Where no guidelines are present, test to within 0.5 bar of the pressure relief valve setting and monitor the pressure gauge value for at least 2 hours.

f) Always flush and clean the system with water before filling with heat transfer fluid (if applicable) or replacing old heat transfer fluid.

g) Only flood a system when the solar collector temperature is below 100°F; ideally BEFORE evacuated tubes and heat pipes are installed. During system maintenance it is only appropriate to drain/fill the system in the morning/evening, or with the collectors covered.

6. Evacuated Tube Installation

⚠ WARNING

DO NOT INSTALL THE HEAT PIPES AND EVACUATED TUBES UNTIL SYSTEM PIPING IS COMPLETED, SYSTEM IS FILLED AND THE PUMP AND CONTROLLER ARE OPERATIONAL

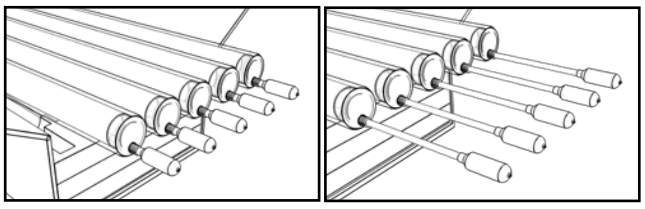
ALWAYS WEAR SAFETY GLASSES WHEN HANDLING EVACUATED TUBES

6.1. Tube & Heat Pipe Preparation

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

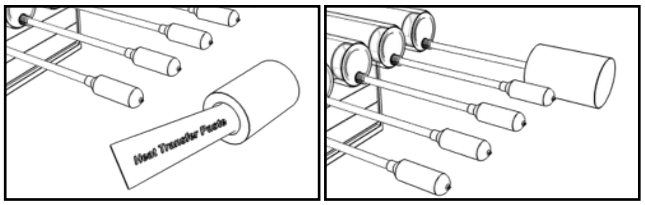
b) Cover the tubes to shade from sunlight, otherwise the heat pipes will get very hot.

c) While holding the top spring plate in place, pull out all the heat pipes by ~6".



d) Coat all the heat heat pipe tips with a very THIN layer of heat transfer paste. The easiest and cleanest way to coat the tips is to use a 6" length of rubber insulation pipe with internal diameter slightly larger than the heat pipe bulb.

e) Squirt some heat transfer paste into the insulation pipe and then insert each heat pipe, coating the bulb with only a thin layer. Ensure the coated paste is not exposed to any dirt or other contaminates.



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

6.2. Tube & Heat Pipe Insertion

a) The heat pipe should still be pulled out of the ET by ~6" to allow the heat pipe to be properly inserted.

b) Lubricate the top outer surface of the evacuated tube with a small amount of water using a wet cloth or spray bottle. This allows easy insertion past the manifold rubber ring seal.

c) Evacuated Tube insertion process:

1. Firmly hold the evacuated tube, taking care to ensure the metal top plate and spring are sitting on the top of the evacuated tube
2. Guide the heat pipe tip in past the manifold rubber seal and into the heat pipe port. Push in full depth.
3. Using a 1/4 left and right turning action, push the evacuated tube up into the manifold. **Do not rotate the tubes around too far in either direction otherwise the heat pipe will end up along the underside of the tube.**

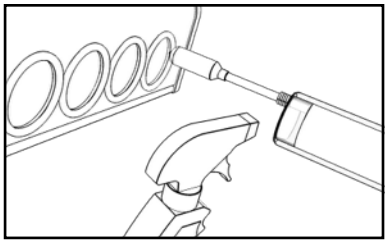
d) The heat pipe and evacuated tube are fully inserted once the dark colored coating of the evacuated tube has entered the manifold (no clear glass visible) and the tube cap flat edge aligns with the bottom track.

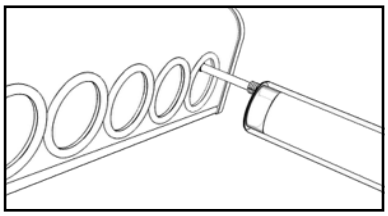
e) Once each tube is inserted, secure the tubes to the bottom track using the stainless steel clips as follows:

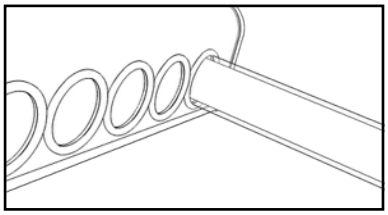
1. Line up the clip hook with the hole in bottom track and push down on one side until a "click" sound is heard.
2. While ensuring the clip is centred over the rubber cap, push down the other side of the clip until it too "clicks" into position.
3. Check to ensure both sides are correctly clipped over the hooks and the clips is aligned between the two ridges of the rubber tube cap.

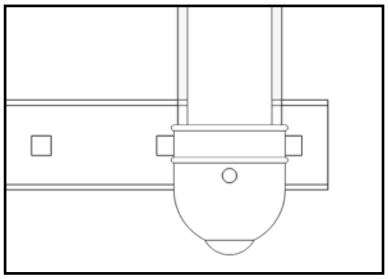
f) The clip can be removed by using a small screwdriver or needle nosed pliers to pull each side outward.

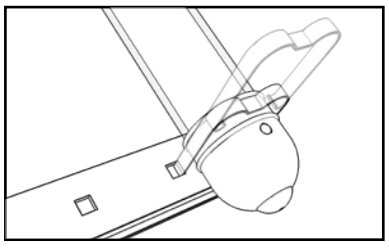
g) If a tube is extends longer than the other tubes the heat pipe may not have been inserted fully into the heat pipe port. Remove the tube and repeat the installation process ensuring that the heat pipe slides in fully before pushing the evacuated tube up into place.











6.3. Post Installation Cleaning

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

7. Temperature Sensor Installation

7.1. Temperature Sensors

a) Ensure that the sensor used on the collector is high temperature rated (up to 390°F), including the cable.

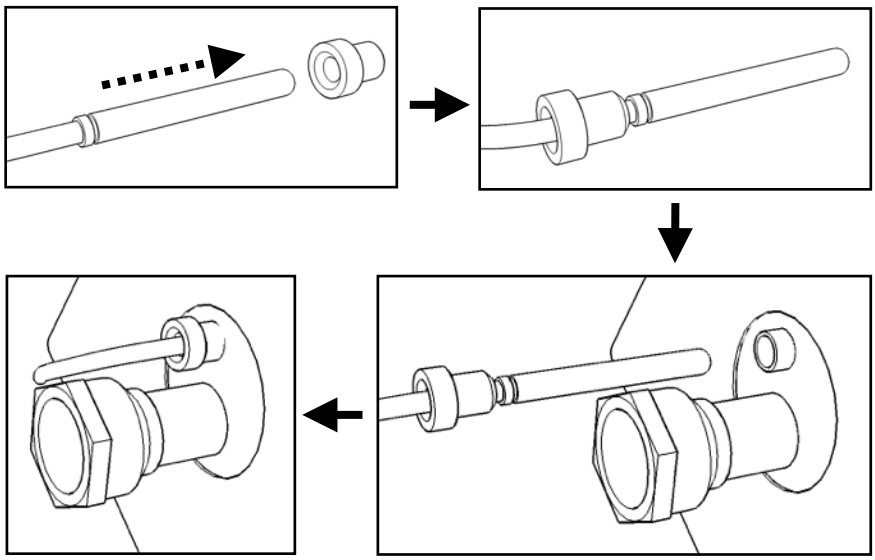
b) The temperature sensor port is located beside the header port. Always insert the sensor into the port on the outlet (hot) port.

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

d) 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 pipe insulation, wrapped with aluminium foil to secure in place and protect from UV exposure.

e) Following these steps to install the sensor:

1. Wet the sensor tip and cable with water.
2. Slide on the rubber sensor plug, past the metal sensor and onto the cable.
3. Dry the sensor.
4. Squirt a small amount of heat transfer paste into the sensor port.
5. Insert the sensor into the sensor port and push rubber plug into place. If the sensor diameter is much smaller than the sensor port, slide a piece of copper wire alongside the sensor to ensure ensure tight metal to metal contact.
6. Secure the cable in place along the outside of the insulation pipe, ideally between the insulation and outer protective jacket. Do NOT run the cable in direct contact with the system piping as the cable will melt.



8. Post Installation Check

After installing all the tubes, and in 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 overhanging trees or objects are likely to fall on the collector	Y	N
4	In areas prone to large hail (∅3/4”), collector is installed at an angle of 40° or greater.	Y	N
5	Frame is secured to structurally sound roof/wall with engineering approval where applicable	Y	N
6	Plumbing is pressure tested and confirmed as leak free (closed loop is holding pressure)	Y	N
7	Plumbing pipe runs are well insulated and sealed against the manifold casing to prevent water ingress.	Y	N
8	Sensor cable is not in contact with system piping or any metal objects, is secured in place along pipeline and protected from direct sunlight.	Y	N
9	Controller is configured correctly with, max tank temperature, max solar collector temperature and freeze setting on (if required).	Y	N
10	System is fitted with pressure relief valve on the pump station (closed) or tank (direct).	Y	N
11	Pressure relief valve will dump only onto high temperature resistant material and will not pose a danger of scolding people.	Y	N
12	Pump, controller and all electrical connections are protected from water ingress.	Y	N
13	Evacuated tubes have been cleaned.	Y	N
14	Installation record form with key information filled in has been given to customer and the system basic operation explained.	Y	N
15	Functional checks for controller and pump have been completed.	Y	N
16	Water quality has been checked (if applicable).	Y	N
17	Installation site has been cleaned.	Y	N

9. 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-AUTHORIZED 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 if SAFE to do so.

9.1. 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.

9.2. Other Components

a) 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 Authorized Persons.

9.3. 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 steps:

1. 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 inside the collector manifold with bare hands, as it can cause mild skin irritation.
2. 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.
3. If the heat pipe is not easy to remove (commonly the case), it can be left in place and a new evacuated tube inserted. Slide the heat pipe down the groove between the evacuated tube inner wall and heat transfer fin.
4. If the heat pipe is easily removed, the easiest option is to replace the heat pipe and evacuated tube completely.

9.4. 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.

9.5. 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).

b) Only drain systems when the collector is operating at a safe temperature (<100°F).

c) Direct flow system draining instructions:

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

d) Closed loop system:

1. Connect hoses to the fill and drain valves on the closed loop pump station and run to a suitable sized vessel or the drain. Consider any local regulations regarding pouring disposal of the heat transfer fluid.
2. Open fill and drain valves.
3. Open the insolation valves at the outlet of each collector where the air vent was installed during commissioning. If there are no isolation valves on the collector outlets, collector fittings may need to be opened to break the vacuum and allow the liquid to drain down.

9.6. Other Components

a) 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.

10. Disclaimer

Apricus Solar Co., Ltd & Apricus Inc withhold 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 or Apricus Inc 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. Troubleshooting

In some cases it may be possible for the those inspection items with an (H) to 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 authorized persons.

The following table includes a range of troubleshooting possibilities covering Closed Loop (CL), Direct Flow (DF) & Drain Back (DB) systems. Items that are specific to one type will have (CL), (DF) or (DB) 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	• This may be normal operatino, but may 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)
	System flow rate too fast	• Adjust restrictor screw on flow setter. (H) • Reduce pump speed (select slower speed) (H)
	Controller settings incorrect	• Solar off (delta-t) value may be set too high. (H)
Pump always ON even during low solar radiation conditions	Insufficient flow rate	• Check flow gauge for proper flow rate (H) • Adjust restrictor screw on flow setter to fully open position (H) • Clean any in-line filters • Check pump operation and speed setting. • 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 Filling procedures (section 5.7)
	Bottom tank sensor not getting accurate reading.	• Check operation of sensor. Should be getting accurate ready of bottom tank temperature. • Ideal position of low tank sensor is slightly ABOVE solar supply (tank to solar) port position.
	Controller settings incorrect	• Solar off (delta-t) value may be set too low. (H)
	Insufficient pump head	• (DB) If no flow achieved, pump head may be insuffient. • (DB) If additional booster pump is used for extra heat, check that it is turning on each time the main pump comes on.
Pump running at night	Controller settings incorrect	• (DF) Check that freeze protection setting is correct. Intermittent circulation during 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 slightly ABOVE solar supply (tank to solar) port position.
Fluid dumping from pressure relief valve on pump station	Faulty pressure relief valve	• (CL) Replace pressure relief valve
	Expansion tank too small	• (CL) Install larger expansion tank
	Expansion tank pressure setting incorrect	• (CL) Check pressure setting. Pressure setting should be set slightly lower than the system cold charge pressure.
	Faulty expansion tank	• (CL) Replace expansion tank on pump station
Lots of fluid dumping from pressure relief valve on tank	Excessive tank temperature	• Check Max Tank setting of controller (H) • Ensure that Max Collector setting is ON and set to <260°F • Check tank sensor operation (that measures top tank temp)
	Faulty expansion tank	• (DF) Replace expansion tank on potable water side
	Faulty pressure reduction value	• Faulty or missing incoming mains supply pressure reduction valve

Problem	Cause	Solution
Tank cooling down at night. It is normal for tank to loose 0.6 - 0.8ºF/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/mixing valve
	Increased hot water demand	• Install larger capacity boiler/booster • Revise boost settings of controller or timer (H) • Install larger storage tank
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 to fully open position (H) • Clean any in-line filters • Check pump operation and speed setting. • 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 resulting in heat loss	• Check that insulation is still in good condition, 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.
	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. Adjust solar on/off controller settings.
	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.
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

12. Manufacturer's Limited Warranty

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.

Components	Failure Type	Coverage
Manifold Box	Manifold Box Leaking Rubber Seal Cracking	Ten years parts
	Manifold Case Colour Fading	One year parts
	Manifold Case Coating Pitting or Peeling	Three year parts
Header Pipe	Leaking	Fifteen years parts
	Brass Fittings	Ten years parts
Evacuated Tube	Complete Loss of Vacuum	Ten years parts
Heat Pipe	Not Transferring Heat	Ten years parts
Mounting Frame	Structural Failure Dimensional Errors Effecting Operation	Fifteen years parts
Tube Clips	Structural Failure	Ten years parts
Tube Caps	Cracking	Ten years parts

WARRANTY EXCLUSIONS

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

General

a) The design or structure of the Products are attempted to be modified or altered in any way, including but 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) Failure due to vibrations or movement of the piping connected to the collector, such as when valve or faucet/tap is closed.
g) Failure is due to wind, hail, storms or other acts of God;
h) Failure or loss of efficiency is due to lime-scale formation;
i) Product serial tag or other identification is defaced or removed;
j) Product is relocated from its original point of installation;
k) Collector is not commissioned and is left to dry stagnate for a period exceeding 14 consecutive days;
l) Any operation or environmental conditions that exceed documented design limits of the system components or materials.

Manifold Casing

a) Damage to the manifold casing during or after installation;
b) Failure to seal insulation up to manifold casing for rear port manifolds;
c) Piping connected to the inlet/outlet is not properly supported causing rubber seal to be pulled out of shape:
d) Gradual colour fade
e) Damage due to attacks by insects or animals
f) Piping connected to the inlet/outlet is "hung" off the collector.

Header Pipe

a) Leakage from any connection to header inlet or outlet;
b) Exposure of the manifold header pipe to pressure exceeding 0.8Mpa/8bar/116psi;
c) Exposure to flow rates exceeding 15 L/min or 4gpm;
d) 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;
g) Installation of more than five end port manifolds in series without at least one suitably flexible connection that allows longitudinal expansion and contraction of the header pipe(s);
h) Piping connection on the inlet/outlet of the collector that restricts longitudinal expansion and contraction of the header pipe(s).
i) Piping connected to the inlet/outlet is "hung" off the collector.
j) Brass fitting has been over torqued, indicated by deformation marks on corners of the HEX of the nut, crossed thread or other clear evidence of incorrect use;
k) Spanner/wrench with teeth (rather than flats) has been used to tighten the fitting;
l) Non Apricus supplied nipple has been used with the flared nut;
m) Copper flare has been deformed from original manufacturer shape.

Evacuated Tubes

a) Heat pipes are not correctly installed full depth into header ports, indicated by deformation of the evacuated tube top plate;
b) Heat pipes are not running straight up and down the top side of the evacuate tube due to excessive rotation of the evacuated tube during installation;
c) Collector mounting frame is installed in twisted (not squared or even) position putting stress on evacuated tubes;

Heat Pipes

a) Heat pipes are installed outside of the required 20-80deg installation angle;
b) Heat pipes have been bent or damaged causing rupture to the copper pipe.

Mounting Frame & Tube Clips

a) Failure attributable to any modification to the mounting frame components;
b) Failure when not installed in accordance with Apricus installation guidelines;
c) Failure of non-Apricus fastening components or the structure to which mounting frame is attached;
d) Failure due to wind loading when the mounting frame has not been installed in line with installation guidelines and local structural codes for high wind regions.
e) Failure due to wind loading in areas that experience >205km/h / 127mph where local structural engineering approval has not been obtained;
f) Failure due to excessive snow loading;

Tube Caps

a) Damage is due to attacks by insects or animals.

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.

13. Installation Record Form

If an installation record form is not provided with the solar system, please use this form.

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 Installer:	
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.