



Apricus AP Solar Collector Specifications



Introduction

The Apricus AP solar collector is manufactured by Apricus Solar Co., Ltd which is an Australian Chinese joint venture based in Nanjing, China,. The collector design was completed in partnership with Powertech Solar Ltd (UK) and has already obtained quality and performance certification from leading testing bodies SPF (Switzerland), Bodycote Materials Testing Canada Inc (for SRCC OG100 certification, USA), and Australian Standards (AS2712, License No. SMKP20405, administered by SAI Global). Testing and auditing for the new European standard “solarkeymark” is currently being completed, and should be obtained by the end of 2005.

Please visit the following websites for more information:

SRCC: www.solar-rating.org

SPF: www.solarenergy.ch

SAI Global: <http://www.sai-global.com/>

Solar Keymark: <http://www.estif.org/solarkeymark/>



At present the AP solar collector are sold in more than 20 countries worldwide. Please visit www.apricus-solar.com/distributors.htm to view company details of official Apricus dealers.

The following pages provide specifications for the AP solar collectors. Some specifications may differ from those shown in the SPF and SRCC reports. This is not because of product differences, but rather differences in standards and measurement methods between countries and testing bodies.

Product Description

The AP range of solar collectors use twin-glass selectively coated evacuated tubes as the solar absorber. Each evacuated tube is fitted with a metal heat transfer fin, which serve two purposes, firstly to aid heat transfer, and secondly to secure the copper heat transfer heat pipes tightly against the inner wall of the evacuated tube. The copper heat pipes are evacuated and contain a small volume of purified H₂O, which, due to the vacuum, at low temperatures (>30°C) boils and vaporizes. The excellent heat transfer properties of the heat pipes facilitate the transfer of thermal energy from within the evacuated tubes to the collector header.

The header comprises two 18mm copper pipes, which have copper “ports” brazed between them. The 18mm copper pipes are contoured to the shape of copper ports in order to increase contact area. In addition the contoured shape of the header creates turbulent water flow, thus further enhancing heat transfer. The heat pipes plug into the header ports, which are tapered at the end to ensure firm contact for optimal heat transfer. The header is insulated with compressed (~70kg/m³) glass wool and housed by 0.8mm thick aluminium outer casing..

The manifold and evacuated tubes are secured to a frame constructed of 1.5mm thick 304-2B stainless steel, with all bolts and fittings also made from 304 stainless steel.

The standard frame suits installation on a pitched roof (clay tiles, corrugated iron, asphalt shingles). For installation on a flat surface, a flat roof adjustable angle frame is available, which is also made from 1.5mm 304-2B stainless steel, with attachment feet made from 2mm thickness stainless steel.

The AP solar collector is suitable for installation in an active, split system configuration, in either a closed or open circulation loop. The header is suitable for potable water flow, or the use of glycol-water mix for enhanced freeze protection.

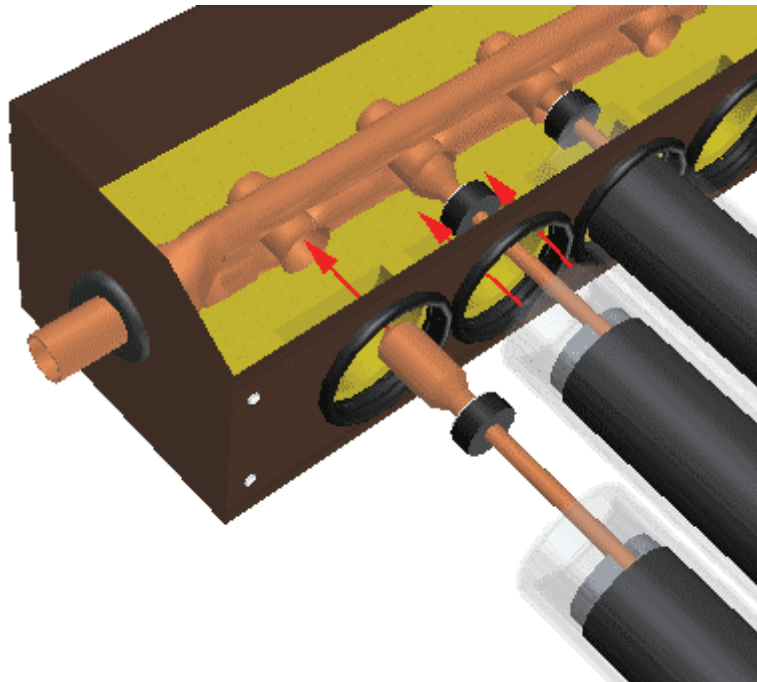
The manifold is designed to be able to withstand wet or dry stagnation without damage to the system, however in a well-designed system stagnation should rarely occur. A temperature relief valve set at <99°C / 212°F should be incorporated into the solar loop plumbing (or on the storage tank) to allow dumping of hot water/pressure if the system stagnates.

The copper header is rated to withstand a maximum pressure of 800kPa / 116psi. SPF and SRCC tested according to 600kPa max pressure (the standard in Europe and USA), but since that time sales in regions with higher mains pressure water levels have required a revision of the max pressure rating. No modifications to the design or manufacturing process have been made to the header to achieve the higher rating, with all headers individually tested to a pressure exceeding 800kPa / 116psi prior to assembly.

General Specifications

Collector Size	10 tubes	18 tubes	20 tubes	22 tubes	30 tubes
Overall Length ¹	1980mm / 80"				
Overall Height ²	156mm / 6.14" (manifold + standard frame)				
Overall Width ³	796mm / 31.3"	1356mm / 53.4"	1496mm / 58.8"	1636mm / 64.4"	2196mm / 86.4"
Absorber Area ⁴	0.8m ² / 0.86ft ²	1.44m ² / 15.5ft ²	1.6m ² / 17.2ft ²	1.76m ² / 18.9ft ²	2.4m ² / 25.8ft ²
Aperture Area ⁵	0.94m ² / 10.1ft ²	1.69m ² / 18.2ft ²	1.88m ² / 20.2ft ²	2.07m ² / 22.3ft ²	2.82m ² / 30.3ft ²
Gross Area	1.57m ² / 16.95ft ²	2.68m ² / 28.8ft ²	2.96m ² / 31.8ft ²	3.24m ² / 34.8ft ²	4.35m ² / 46.8ft ²
Gross Dry Weight (Standard Frame)	34.8kg / 76.5p	58.2kg / 128p	63.5kg / 139.7p	71.3kg / 156.8p	94.8kg / 208.5p
Fluid Capacity	290ml / 9.8oz	490ml / 16.57oz	520ml / 17.58oz	550ml / 18.6oz	710ml / 24oz

1. Length of frame front track
2. Height of frame front track + manifold
3. Width of manifold (not including inlet/outlet ports for end port model)
4. Absorber = Outside diameter of inner tube x exposed tube length
5. Aperture = Inner diameter of outer glass tube x exposed tube length
6. Collector model naming system: APCP-N. Eg. APKR-22, APSE-30
 AP = Apricus AP solar collector
 C = casing finish: *K* = Black, *S* = Silver
 P = port location: *R* = Rear, *E* = End
 N = Number of tubes: 10, 18, 20, 22, 30



Cutaway view of manifold showing copper header and heat pipe insertion format

Component Specifications

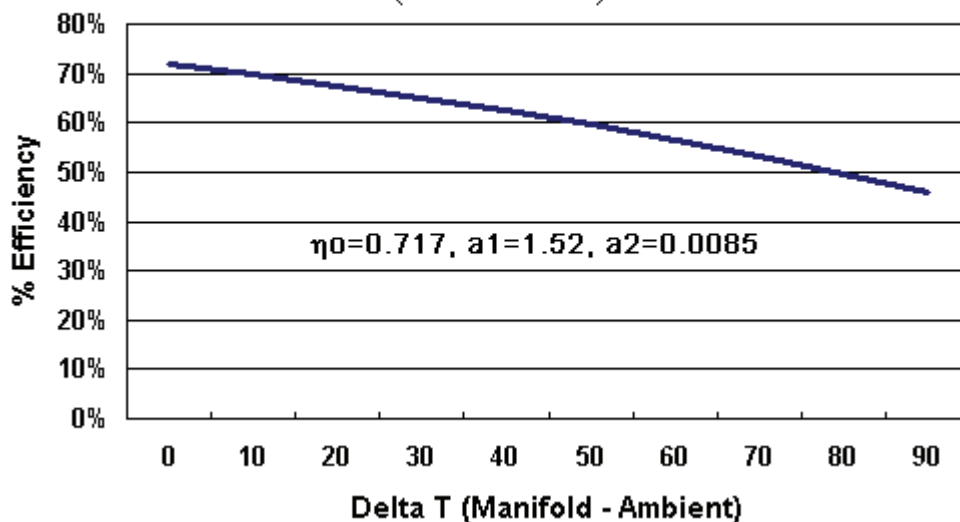
Copper Header	
Material	>99.93% Copper Sn<0.012%, Zn<0.04%, Pb<0.003%, Fe<0.004%, Ni<0.003%, As<0.002%, S<0.003%, Bi<0.001%, Sb<0.002%
Length (mm) Rear Port Models (Inlet center to outlet center)	L = (X-1) x 70 + 80 (X=No. tubes) L = (X-1) x 2.759" + 3.15"
Length (mm) End Port Models (overall length)	L = (X-1) x 70 + 240 (X=No. tubes) L = (X-1) x 2.759" + 9.45"
Header Pipe Dimensions	Ø18mm OD x 1.2mm 0.7" OD x 0.047"
Brazing Rod Material	45% Silver, 30% Copper, 25% Zinc Lead and Cadmium Free
Inlet & Outlet	Ø22mm OD 0.866" OD (Attachment by supplied brass compression fittings only)
Temperature Sensor Port	Ø10 OD x 1.0mm Ø0.39"OD x 0.039"
Recommended Flow Rate	0.1L/tube/min (10tube = 1 L/min) 0.026G/tube/min (10tube = 0.26G/min)
Max Flow Rate	15L/min / 3.9G/min regardless of collector size.
Max Operating Pressure Rating	800kPa / 116psi (850kPa / 123psi PRV acceptable)
Manifold Casing	
Manifold Length	L = (X-1) x 70mm + 160mm (X=No. tubes) L = (X-1) x 2.759" + 6.3"
Lid Length (mm)	Manifold Length + 6mm / 0.236"
Height (lid on)	131mm / 5.157"
Width	140mm / 5.512"
Tube Spacing	70mm / 2.759"
Manifold Material	0.8mm Aluminium (Grade 3A21) Silver Enamel Painted or Black Powder Coated (PF - Phenol Formaldehyde Resin)
Frame	
Material	1.5mm / 0.059" thick 304-2B Stainless Steel
SS Tube Clips	301 Stainless Steel
Bolts, Washers and Nuts	430 Stainless Steel
Insulation	
Material	Compressed Glass Wool
Insulation Factor	K = 0.043W/mK

Evacuated Tubes (Solar Absorber)	
Tube Length	1800mm / 70.8" (Actual length to tip = 1810-1830mm / 71.25"-72")
Outer Tube Dimensions	Ø58mm x 1.6mm / Ø2.28" x 0.063"
Inner Tube Dimensions	Ø47mm x 1.6mm / Ø1.85" x 0.063"
Weight	2kg / 4.4pounds
Solar Tubes Material	Borosilicate Glass 3.3
Solar Tube Coating	Graded-index coating Al-N on Al on glass
Thermal Expansion	3.3x10⁻⁶ °C
Absorptance (α)	>92% (AM1.5)
Emittance (ε)	<8% (80°C)
Vacuum	P<5x10⁻³ Pa
Stagnation Temperature	>200°C >395°F
Heat Loss	<0.8W/ (m² °C)
Maximum Strength	0.8Mpa 120psi
Absorber Area per Tube	0.08m² 0.86ft²
Heat Pipes & Heat Transfer Fins (Heat Transfer)	
Length	1800mm 70.8"
Material	Oxygen Free Copper (TU1) Cu+Ag> 99.99% (O₂ <16ppm)
Copper Pipe Dimensions	Ø8mm OD x 0.7mm thick
Condenser Dimensions	20mm OD x 30mm
Heat Transfer Material	Purified Water (Non Toxic)
Maximum Working Temperature	300°C 577°F
Startup Temperature	<30°C <86°F
Vacuum	P<5x10⁻³ Pa
Vertical Installation Angle	20-70°
Horizontal Installation Angle	0° +/- 5°
Heat Transfer Fins	0.2mm thick Hot Dipped Zn Coated Iron (Q235 grade steel, 100g/m² Zn coating)
Freeze Protection Sleeve	Ø8mm OD x 1mm x 150mm 304-SS
Rubber Components	
Material	HTV Silicone Rubber
Density	1.15 g/cm³ +/- 0.05
Durometer Hardness (Shore A)	60
Elongation	320%
Rebound	54%
Maximum Working Temperature	300°C 577°F
Tensile Strength	6.4 Mpa
Tear Strength	12.5 KNM

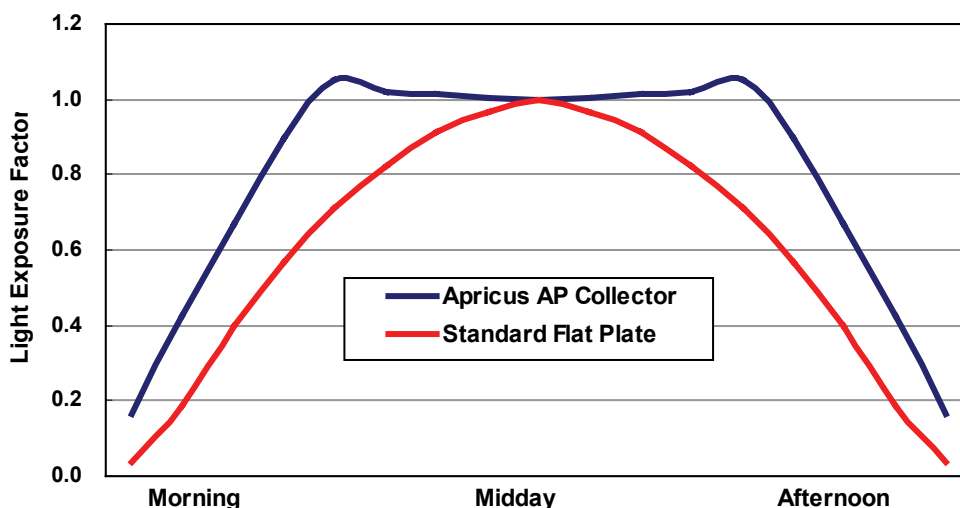
Performance and Quality

Stagnation SPF Report No. C632LPEN	245°C, when $G = 1000\text{W/m}^2$, Ambient Temp = 30°C 477°F, when $G = 317\text{Btu/ft}^2$, Ambient Temp = 86°F									
Efficiency SPF Report No. C632LPEN	$\eta_0 (-) = 0.717$, $a_1 (\text{W/m}^2\text{K}) = 1.52$, $a_2 (\text{W/m}^2\text{K}^2) = 0.0085$ $G = 800\text{W/m}^2 / 253\text{Btu/ft}^2$ based on Absorber area.									
Quality Certifications	SPF Solar Collector Quality Test Certificate No. C632QPEN (SPF Quality Test According to: EN 12975-2: 2001, Section 5)									
	SRCC OG100 Award of Collector Certification Certification No. 100-2004003A,B,C,D Testing conducted by Bodycote Materials Testing Canada Inc.									
	Australian Standards Mark Plumbing AS2712 (License No. SMKP20405)									
Incidence Angle Modifier	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
Kθ (longitudinal)						0.93				
Kθ (transversal)	1.0	1.02	1.08	1.18	1.37	1.4	1.34	1.24	0.95	0.0

AP Solar Collector Efficiency Curve
($G=800\text{W/m}^2$)

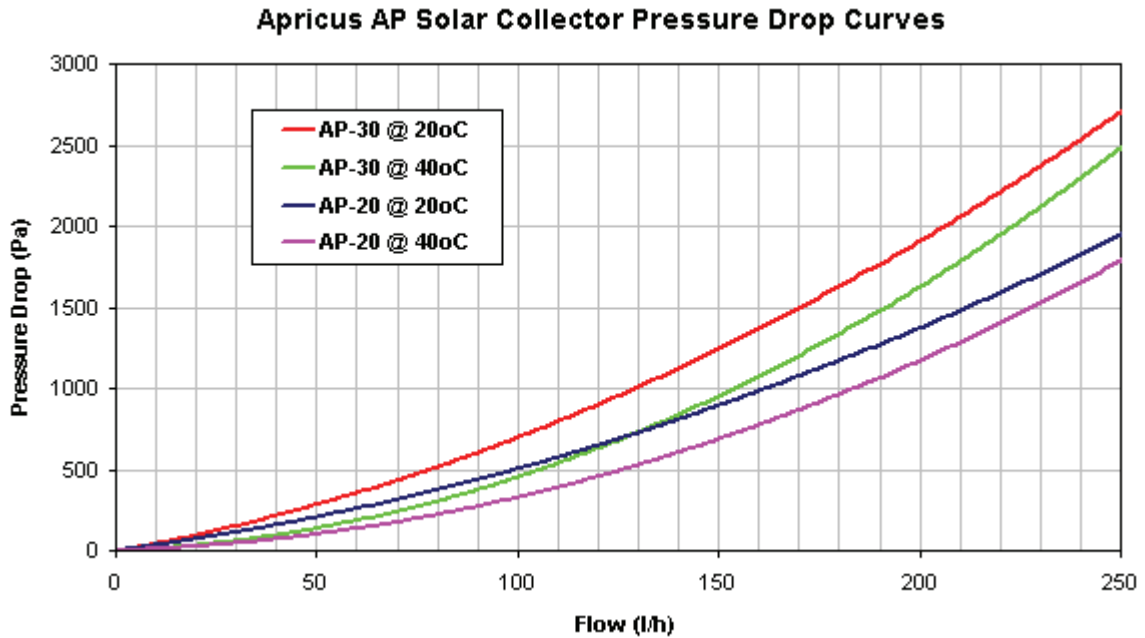


Daily Light Exposure Curves



Pressure Drop

The pressure drop of the AP-20 and AP-30 solar collectors are shown in the graph below. In a domestic application, the pressure drop levels are very minimal. Pressure drop levels for other manifold sizes can be easily estimated based on the curves presented. For installations with more than one collector, simply multiply by the number of manifolds used to obtain total pressure drop.



Embedded Carbon Emissions

The follow table provided approximate energy usage and resultant carbon emission involved in the product of the various components of the AP solar collector, therefore provide a total embedded carbon value.

Material	Weight (kg)	Raw Material Standard Energy Usage Values	Manufacturing Factor*	Energy Usage (kWh/kg)	Total Energy Usage (kWh)	Total CO ₂ (kg)**
304 Stainless Steel	8.1	0.98 kgC/kg	2	6.44	52.2	52.2
Aluminium	2.6	15 kWh/kg	1.2	18	46.8	46.8
Copper	11.8	1.123 kgC/kg	2	7.78	91.8	91.8
Glass	65	0.257 kgC/kg	1.2	1.01	65.7	65.7
Silicone Rubber	2	1.2 kgC/kg	2	7.89	15.8	15.8
Cardboard Packing	18.5	1.57 kgC/kg	1.2	6.19	114.5	114.5
TOTAL					386.7	386.7

* Factor to consider additional energy used during manufacturing of final product.

** Based on 1kg of CO₂ per kWh of energy used.

Approximate values for each model size		kg of CO ₂
AP-10	128.90	
AP-18	232.03	
AP-20	257.81	
AP-22	283.59	
AP-30	386.71	

"Payback" time based on average insolation value of 4kWh/m²/day and solar conversion of 65% = 62 days

AP Solar Collector Flat Roof Frame Feet Spacing

When installing the flat roof frame, concrete blocks may need to be prepared.
The following are the distances between consecutive lateral or front and rear feet.

1.8m FRAME FRONT TO REAR FOOT SPACING:

51.7° = 1406mm / 55.35" (Top Front Track Hole) *

44.8° = 1565mm / 61.6" (Top Front Track Hole)

38.7° = 1688mm / 66.45" (Top Front Track Hole)

33.0° = 1792mm / 70.55" (Top Front Track Hole)

28.4° = 1725mm / 67.9" (Bottom Front Track Hole)

23.4° = 1775mm / 69.9" (Bottom Front Track Hole) **

* This is the maximum rear leg height. Do not extend the legs so that only one bolt is connecting them together, as this does not provide sufficient structural integrity. For an angle greater than 51.7° raise the height of the base to which the rear legs are bolted.

** In order to ensure optimal heat pipe operation, the AP solar collector should not be installed at an angle of less than 20°. Flat roof frame angle settings lower than 23.4° should only be used when installing on a pitched surface, such that the total angle is greater than 20°.

LATERAL FEET SPACING:

AP-10 (2 legs) = 490mm / 19.29"

AP-18 (2 legs) = 1050mm / 41.34"

AP-20 (2 legs) = 1190mm / 46.85"

AP-22 (3 legs) = 665mm / 26.18"

AP-30 (3 legs) = 945mm / 37.2"

In all cases the standard location for the front tracks is beneath the second tube from each end (For AP-22 and AP-30, the third leg is located in a central position). The standard distance between the rear X brace attachment bolts on the rear legs is 600mm (4 holes). Choosing holes further apart, or closer together for the rear X brace attachment points on the rear legs will bring the feet closer together, or splay them further apart, respectively.

DISTANCE BETWEEN CONSECUTIVE COLLECTORS:

The distance between the last foot of one collector, and the first foot of the next collector (centre of feet) in series will depend on whether END or REAR port manifolds are being used. For END port manifolds, this will also depend on what connector is being used. The values below for AP-END are based on using a straight 22C x 22C fitting.

AP-REAR = 165mm / 6.5" (5mm / 0.19" gap between manifold end panels)

AP-END = 366mm / 14.4"

Note: All values accurate to +/- 5mm.