



Apricus AP Solar Collector Specifications



Introduction

The Apricus AP solar collector is manufactured by Apricus Solar Co., Ltd 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 number SMKP20405). In addition, Apricus Solar Co., Ltd is an ISO9001:2000 quality management certified company, Licence number 22384.

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/>



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 heat pipes are freeze protected, meaning that in very cold conditions, when the water inside the heat pipe freezes, no damage to the copper pipe occurs.

The header comprises two 18mm / 0.7" copper pipes, which have copper "ports" brazed between them. The copper pipes are contoured to the shape of copper ports in order to increase contact surface 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 an aluminum outer casing..

The manifold and evacuated tubes are secured to a frame constructed of stainless steel, with all bolts and fittings also made from stainless steel.

The standard frame suits installation on a pitched roof (clay tiles, corrugated iron, asphalt shingles). For installation on other surfaces, Low, Mid, High or Fixed angle frame kits are available, also made from 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, or a heat dissipation loop should included.

General Specifications

Collector Size	10 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"	1496mm / 58.8"	1636mm / 64.4"	2196mm / 86.4"
Absorber Area ⁴	0.8m ² / 8.6ft 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	1.88m ² / 20.2ft ²	2.07m ² / 22.3ft ²	2.82m ² / 30.3ft ²
Gross Area	1.57m ² / 16.95ft ²	2.96m ² / 31.8ft ²	3.24m ² / 34.8ft ²	4.35m ² / 46.8ft ²
Gross Dry Weight (Standard Frame)	34.8kg / 76.5lb	63.5kg / 139.7lb	71.3kg / 156.8lb	94.8kg / 208.5lb
Fluid Capacity	290ml / 9.8floz	520ml / 17.58floz	550ml / 18.6oz	710ml / 24floz

1. Length of frame front track
2. Height of frame front track + manifold
3. Width of manifold (not including inlet/outlet ports)
4. Absorber = Outside diameter of inner tube x exposed tube length
5. Aperture = Inner diameter of outer glass tube x exposed tube length

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 (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 Materials	45% Silver, 30% Copper, 25% Zinc (BAg45CuZn) & 93% Copper 7% Phosphorus (BCu93P)
Inlet & Outlet	Ø22mm OD 0.866" OD (Attachment by supplied brass compression fittings or soldered)
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	$L = (X-1) \times 70\text{mm} + 160\text{mm}$ (X=No. tubes) $L = (X-1) \times 2.759'' + 6.3''$
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) 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	304 Stainless Steel

Insulation	
Material	Compressed Glass Wool (~70kg/m ³ / 1.33lb/ft ³)
Insulation Factor	K = 0.043W/mK R = 1.16K.m ² /W or 6.6ft ² .°F.h/Btu

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/ (m ² °C)
Maximum Strength	0.8Mpa 120psi
Absorber Area per Tube	0.08m ² 0.86ft ²

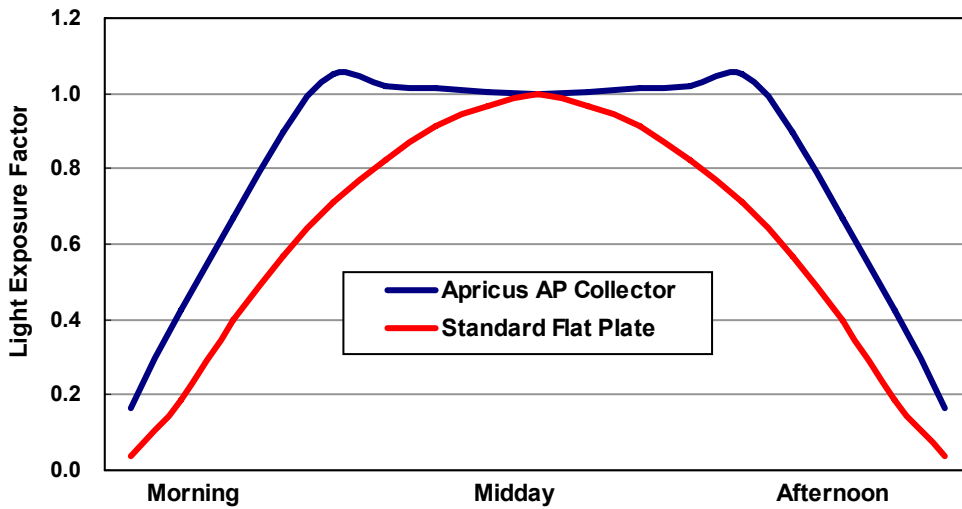
Heat Pipes & Heat Transfer Fins (Heat Transfer)	
Length	1800mm 70.8"
Material	Oxygen Free Copper (TU1) Cu+Ag> 99.99% (O ₂ <16ppm)
Copper Pipe Dimensions	Ø8mm OD x 0.7mm thick
Condenser Dimensions	20mm OD x 30mm
Heat Transfer Material	Purified Water (Non Toxic)
Maximum Working Temperature	300°C 577°F
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/m ² Zn coating)
Freeze Protection Sleeve	Ø8mm OD x 1mm x 150mm 304-SS

Rubber Components	
Material	HTV Silicone Rubber
Density	1.15 g/cm ³ +/- 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 = 1000W/m ² , Ambient Temp =30°C 477°F, when G = 317Btu/ft ² , Ambient Temp = 86°F									
Efficiency SPF Report No. C632LPEN	η_0 (-) = 0.717, a_1 (W/m ² K) = 1.52, a_2 (W/m ² K ²) = 0.0085 G = 800W/m ² / 253Btu/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°
K_θ (longitudinal)						0.93				
K_θ (transversal)	1.0	1.02	1.08	1.18	1.37	1.4	1.34	1.24	0.95	0.0

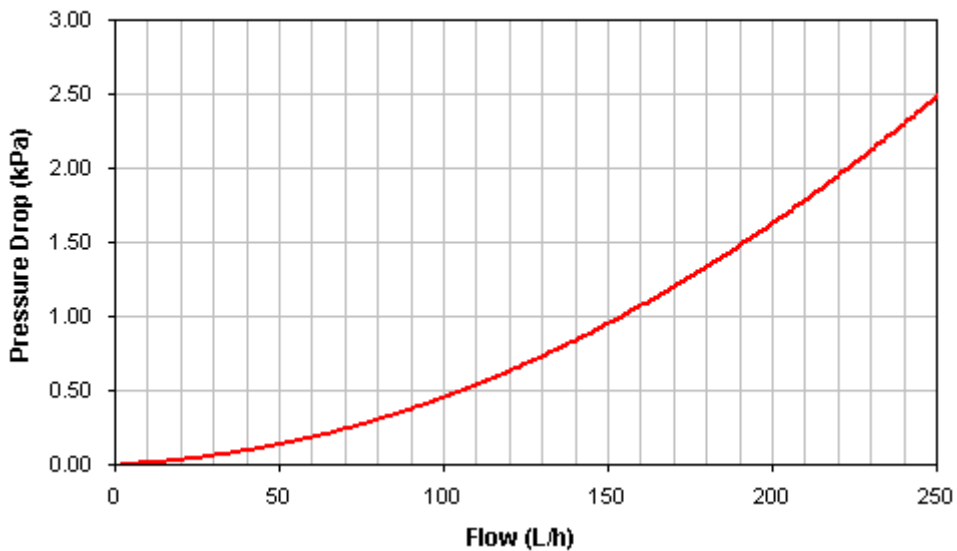
Daily Light Exposure Curves



Pressure Drop

The pressure drop of the AP-30 solar collector is 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 multiple by the number of manifolds used to obtain total pressure drop. This graph is based on cold water, hot water has a lower pressure drop.

Apricus AP-30 Solar Collector Pressure Drop Curve



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	
AP-10	128.90
AP-18	232.03
AP-20	257.81
AP-22	283.59
AP-30	386.71

kg of CO₂
(1kg = 2.2lb)

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

High Angle Roof Frame Feet Spacing

When installing the high 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-20 (2 legs) = 1190mm / 46.85"

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-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.