

**City of Portland, Maine - Building or Use Permit Application**

389 Congress Street, 04101 Tel: (207) 874-8703, Fax: (207) 874-8716

Permit No: 09-0761	Issue Date: 7/21/09	CBL: 159 D025001
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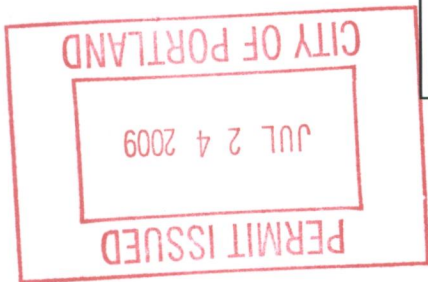
Location of Construction: 18 VICTOR RD	Owner Name: REDFERN PROPERTIES LLC	Owner Address: PO BOX 8816	Phone: 207-221-6342
Business Name:	Contractor Name: Revision Energy LLC	Contractor Address: 142 Presumpscot street Portland	Phone: 2073231805
Lessee/Buyer's Name	Phone:	Permit Type: HVAC	Zone:

Past Use: Single Family Home	Proposed Use: Single Family Home - Install Apricus Solar Heating System	Permit Fee: \$240.00	Cost of Work: \$21,305.00	CEO District: 4
Proposed Project Description: Install Apricus Solar Heating System		FIRE DEPT: <input type="checkbox"/> Approved <input type="checkbox"/> Denied	INSPECTION: Use Group: R-3 Type: SB IRC-2003	
		Signature:	Signature: <i>cl</i>	
PEDESTRIAN ACTIVITIES DISTRICT (P.A.D.)				
Action: <input type="checkbox"/> Approved <input type="checkbox"/> Approved w/Conditions <input type="checkbox"/> Denied				
Signature: _____ Date: _____				

Permit Taken By: lmd	Date Applied For: 07/21/2009	<b>Zoning Approval</b>		
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- This permit application does not preclude the Applicant(s) from meeting applicable State and Federal Rules.
- Building permits do not include plumbing, septic or electrical work.
- Building permits are void if work is not started within six (6) months of the date of issuance. False information may invalidate a building permit and stop all work..

Special Zone or Reviews	Zoning Appeal	Historic Preservation
<input type="checkbox"/> Shoreland	<input type="checkbox"/> Variance	<input type="checkbox"/> Not in District or Landmark
<input type="checkbox"/> Wetland	<input type="checkbox"/> Miscellaneous	<input checked="" type="checkbox"/> Does Not Require Review
<input type="checkbox"/> Flood Zone	<input type="checkbox"/> Conditional Use	<input type="checkbox"/> Requires Review
<input type="checkbox"/> Subdivision <i>O.K.</i>	<input type="checkbox"/> Interpretation	<input type="checkbox"/> Approved
<input type="checkbox"/> Site Plan	<input type="checkbox"/> Approved	<input type="checkbox"/> Approved w/Conditions
Maj <input type="checkbox"/> Minor <input type="checkbox"/> MM <input type="checkbox"/>	<input type="checkbox"/> Denied	<input type="checkbox"/> Denied
Date: <i>7/21/09 cl</i>	Date: _____	Date: <i>7/21/09</i>



**CERTIFICATION**

I hereby certify that I am the owner of record of the named property, or that the proposed work is authorized by the owner of record and that I have been authorized by the owner to make this application as his authorized agent and I agree to conform to all applicable laws of this jurisdiction. In addition, if a permit for work described in the application is issued, I certify that the code official's authorized representative shall have the authority to enter all areas covered by such permit at any reasonable hour to enforce the provision of the code(s) applicable to such permit.

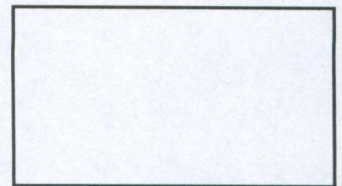
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SIGNATURE OF APPLICANT ADDRESS DATE PHONE

\_\_\_\_\_  
RESPONSIBLE PERSON IN CHARGE OF WORK, TITLE DATE PHONE



FILL IN AND SIGN WITH INK

# APPLICATION FOR PERMIT HEATING OR POWER EQUIPMENT



To the INSPECTOR OF BUILDINGS, PORTLAND, ME.

The undersigned hereby applies for a permit to install the following heating, cooking or power equipment in accordance with the Laws of Maine, the Building Code of the City of Portland, and the following specifications:

Location / CBL 159-D-025001 Use of Building Single family Date 7-20-09

Name and address of owner of appliance 18 VICTOR RD PORTLAND, ME 04103

Installer's name and address Revision Energy 142 Presumpscot St Portland, ME 04103  
Telephone (207) 221-6342

### Location of appliance:

- Basement
- Floor
- Attic
- Roof

### Type of Fuel:

- Gas
- Oil
- Solid SOLAR

Appliance Name: Apricus  
U.L. Approved  Yes  No

Will appliance be installed in accordance with the manufacture's installation instructions?  Yes  No

IF NO Explain: \_\_\_\_\_

### The Type of License of Installer:

- Master Plumber # 02765
- Solid Fuel # \_\_\_\_\_
- Oil # \_\_\_\_\_
- Gas # \_\_\_\_\_
- Other MS60019303

### Type of Chimney:

- Masonry Lined  
Factory built \_\_\_\_\_
- Metal  
Factory Built U.L. Listing # \_\_\_\_\_
- Direct Vent  
Type \_\_\_\_\_ UL# \_\_\_\_\_

### Type of Fuel Tank

- Oil
- Gas

Size of Tank \_\_\_\_\_

Number of Tanks \_\_\_\_\_

Distance from Tank to Center of Flame \_\_\_\_\_ feet.

Cost of Work: \$ 21,305

Permit Fee: \$ 230

### Approved

Fire: \_\_\_\_\_  
Ele.: \_\_\_\_\_  
Bldg.: \_\_\_\_\_

### Approved with Conditions

- See attached letter or requirement

Cheryl L. [Signature]  
Inspector's Signature

7/21/09  
Date Approved

Signature of Installer [Signature]

**City of Portland, Maine - Building or Use Permit**

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<b>Permit No:</b> 09-0761	<b>Date Applied For:</b> 07/21/2009	<b>CBL:</b> 159 D025001
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<b>Business Name:</b>	<b>Contractor Name:</b> Revision Energy LLC	<b>Contractor Address:</b> 142 Presumpscot street Portland	<b>Phone:</b> (207) 323-1805
<b>Lessee/Buyer's Name</b>	<b>Phone:</b>	<b>Permit Type:</b> HVAC	

<b>Proposed Use:</b> Single Family Home - Install Apricus Solar Heating System	<b>Proposed Project Description:</b> Install Apricus Solar Heating System
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<b>Dept:</b> Zoning	<b>Status:</b> Approved	<b>Reviewer:</b> Chris Hanson	<b>Approval Date:</b> 07/21/2009
<b>Note:</b>			<b>Ok to Issue:</b> <input checked="" type="checkbox"/>
<b>Dept:</b> Building	<b>Status:</b> Approved with Conditions	<b>Reviewer:</b> Chris Hanson	<b>Approval Date:</b> 07/21/2009
<b>Note:</b>			<b>Ok to Issue:</b> <input checked="" type="checkbox"/>
1) Solar Energy Systems must comply with section M2301 of the IRC2003.			
2) Equipment must be installed in compliance per the manufacturer's specifications			

**BUILDING PERMIT INSPECTION PROCEDURES**

**Please call 874-8703 or 874-8693 (ONLY )**

**to schedule your inspections as agreed upon**

**Permits expire in 6 months, if the project is not started or ceases for 6 months.**

The Owner or their designee is required to notify the inspections office for the following inspections and provide adequate notice. Notice must be called in 48-72 hours in advance in order to schedule an inspection:

**By initializing at each inspection time, you are agreeing that you understand the inspection procedure and additional fees from a "Stop Work Order" and "Stop Work Order Release" will be incurred if the procedure is not followed as stated below.**

**A Pre-construction Meeting will take place upon receipt of your building permit.**

  X   **Final inspection required at completion of work.**

Certificate of Occupancy is not required for certain projects. Your inspector can advise you if your project requires a Certificate of Occupancy. All projects DO require a final inspection.

**If any of the inspections do not occur, the project cannot go on to the next phase, REGARDLESS OF THE NOTICE OR CIRCUMSTANCES.**

**CERIFICATE OF OCCUPANICES MUST BE ISSUED AND PAID FOR, BEFORE THE SPACE MAY BE OCCUPIED.**

\_\_\_\_\_  
Signature of Applicant/Designee

\_\_\_\_\_  
Date

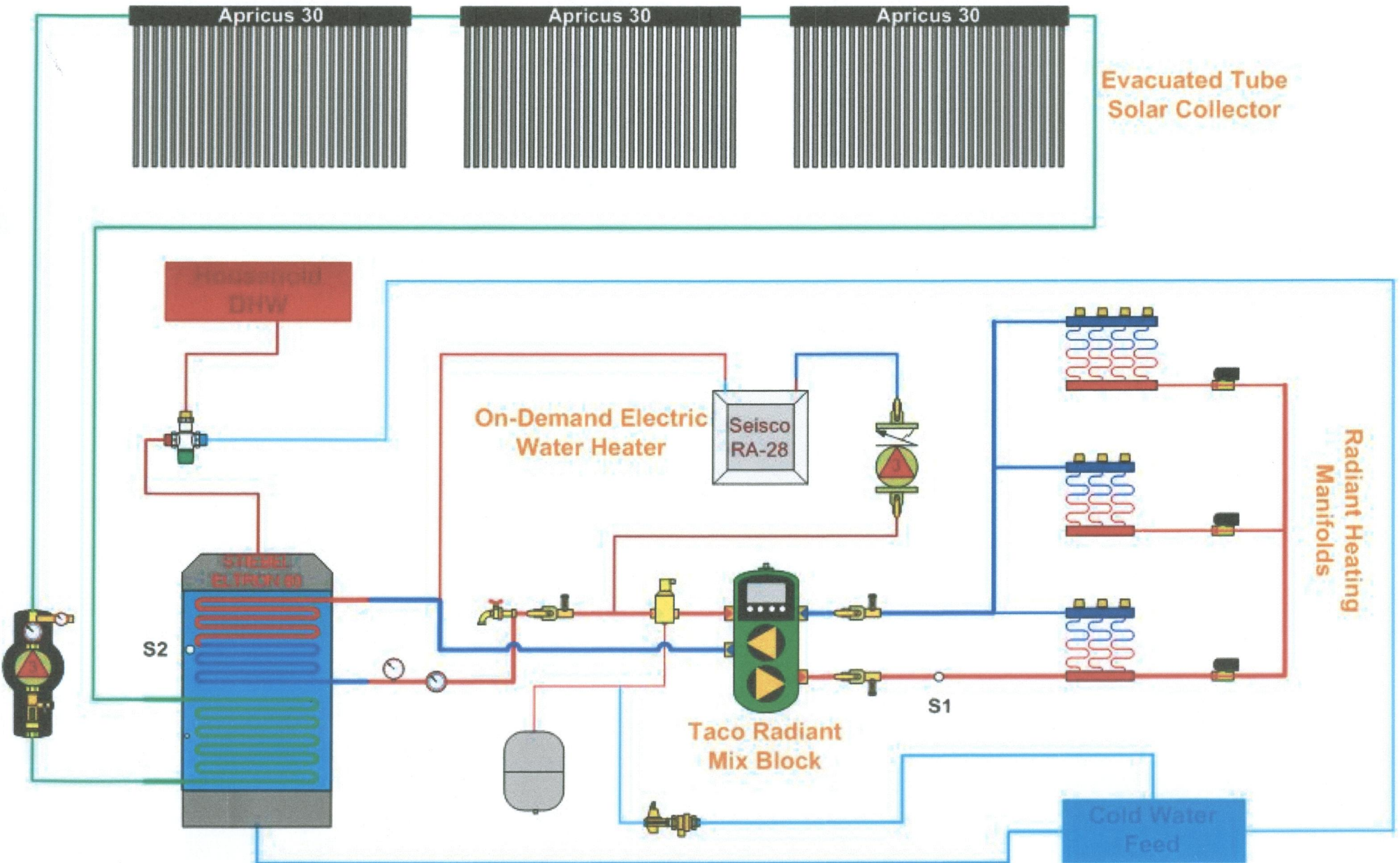
\_\_\_\_\_  
Signature of Inspections Official

\_\_\_\_\_  
Date

System 1 (SHW Space Heat/Seisco ODWH in parallel/Taco RMB)--Piping

Design  
By:

ReVision Energy





## Apricus AP Solar Collector Specifications



## Introduction

The Apricus AP solar collector is manufactured by Focus Technology Co., Ltd of Nanjing, China. The 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)

Please visit the following websites for more information:

SRCC: [www.solar-rating.org](http://www.solar-rating.org)

SPF: [www.solarenergy.ch](http://www.solarenergy.ch)

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



At present the AP solar collector is sold in the following countries:

Australia, USA, Canada, Middle East, UK, Italy, France, Sweden, Bulgaria, Greece, Cyprus, Hungary, Spain, New Zealand, Mexico, Malaysia, Singapore, Taiwan and South Africa with new distributors being established in many new areas.

Please visit [www.apricus-solar.com/distributors.htm](http://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 solar tubes as the solar absorber. Each solar 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 solar tube. The copper heat pipes are evacuated and contain a small volume of purified H<sub>2</sub>O, 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 solar 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/m<sup>3</sup>) glass wool and housed by powder coated (UV stabilized) 0.8mm thick aluminium.

The manifold and solar 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.

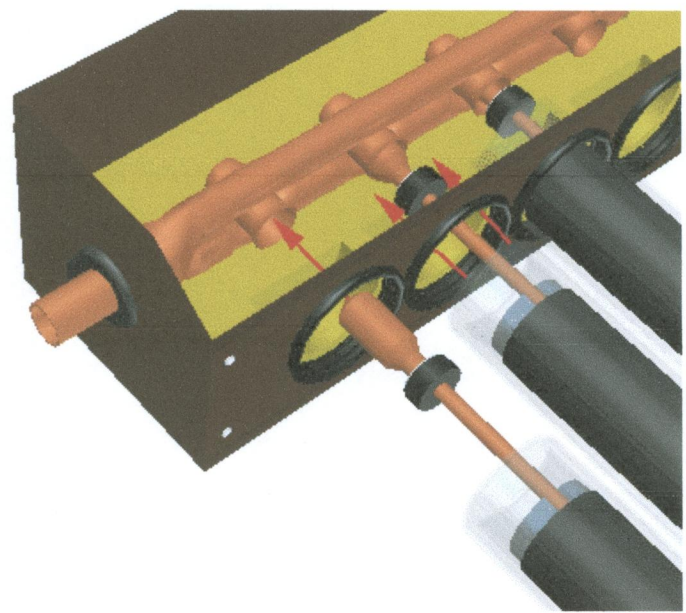


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## General Specifications

Collector Size	10 tubes	18 tubes	20 tubes	22 tubes	30 tubes
Overall Length <sup>1</sup>	1980mm / 80"				
Overall Height <sup>2</sup>	156mm / 6.14" (manifold + standard frame)				
Overall Width <sup>3</sup>	796mm / 31.3"	1356mm / 53.4"	1496mm / 58.8"	1636mm / 64.4"	2196mm / 86.4"
Absorber Area <sup>4</sup>	0.8m <sup>2</sup> / 0.86ft <sup>2</sup>	1.44m <sup>2</sup> / 15.5ft <sup>2</sup>	1.6m <sup>2</sup> / 17.2ft <sup>2</sup>	1.76m <sup>2</sup> / 18.9ft <sup>2</sup>	2.4m <sup>2</sup> / 25.8ft <sup>2</sup>
Aperture Area <sup>5</sup>	0.94m <sup>2</sup> / 10.1ft <sup>2</sup>	1.69m <sup>2</sup> / 18.2ft <sup>2</sup>	1.88m <sup>2</sup> / 20.2ft <sup>2</sup>	2.07m <sup>2</sup> / 22.3ft <sup>2</sup>	2.82m <sup>2</sup> / 30.3ft <sup>2</sup>
Gross Area	1.57m <sup>2</sup> / 16.95ft <sup>2</sup>	2.68m <sup>2</sup> / 28.8ft <sup>2</sup>	2.96m <sup>2</sup> / 31.8ft <sup>2</sup>	3.24m <sup>2</sup> / 34.8ft <sup>2</sup>	4.35m <sup>2</sup> / 46.8ft <sup>2</sup>
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



## Component Specifications

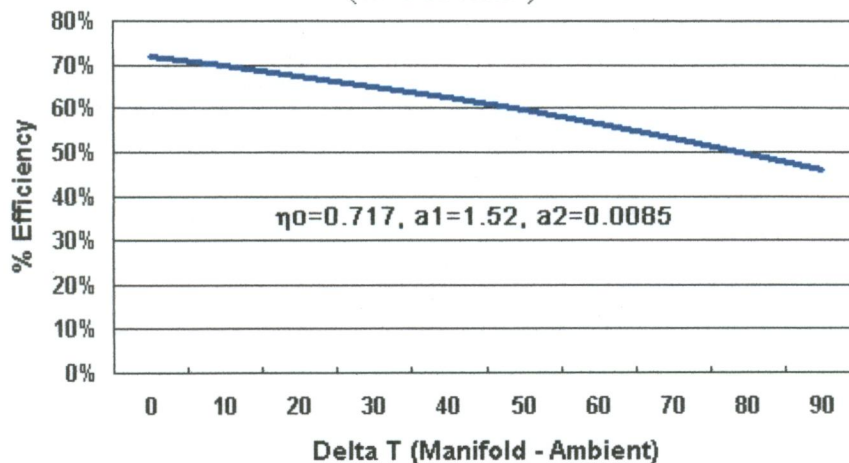
Copper Header	
<b>Material</b>	<b>&gt;99.93% Copper</b> Sn<0.012%, Zn<0.04%, Pb<0.003%, Fe<0.004%, Ni<0.003%, As<0.002%, S<0.003%, Bi<0.001%, Sb<0.002%
<b>Length (mm) Rear Port Models</b> (Inlet center to outlet center)	<b>L = (X-1) x 70 + 80 (X=No. tubes)</b> <b>L = (X-1) x 2.759" + 3.15"</b>
<b>Length (mm) End Port Models</b> (overall length)	<b>L = (X-1) x 70 + 240 (X=No. tubes)</b> <b>L = (X-1) x 2.759" + 9.45"</b>
<b>Header Pipe Dimensions</b>	<b>Ø18mm OD x 1.2mm</b> <b>0.7" OD x 0.047"</b>
<b>Brazing Rod Material</b>	<b>45% Silver, 30% Copper, 25% Zinc</b> <b>Lead and Cadmium Free</b>
<b>Inlet &amp; Outlet</b>	<b>Ø22mm OD    0.866" OD</b> (Attachment by brass compression fittings only)
<b>Temperature Sensor Port</b>	<b>Ø10 OD x 1.0mm</b> <b>Ø0.39"OD x 0.039"</b>
<b>Recommended Flow Rate</b>	<b>0.1L/tube/min (10tube = 1 L/min)</b> <b>0.026G/tube/min (10tube = 0.26G/min)</b>
<b>Max Flow Rate</b>	<b>15L/min / 3.9G/min regardless of collector size.</b>
<b>Pressure Drop</b>	<b>0.7kPa @ 3.3L/min for 20 tube manifold</b>
<b>Max Operating Pressure Rating</b>	<b>800kPa / 116psi</b> (850kPa / 123psi PRV acceptable)
Manifold Casing	
<b>Manifold Length</b>	<b>L = (X-1) x 70mm + 160mm (X=No. tubes)</b> <b>L = (X-1) x 2.759" + 6.3"</b>
<b>Lid Length (mm)</b>	<b>Manifold Length + 6mm / 0.236"</b>
<b>Height (lid on)</b>	<b>131mm / 5.157"</b>
<b>Width</b>	<b>140mm / 5.512"</b>
<b>Tube Spacing</b>	<b>70mm / 2.759"</b>
<b>Manifold Material</b>	<b>0.8mm Aluminium (Grade 3A21)</b> <b>Powder Coated (PF - Phenol Formaldehyde Resin)</b>
Frame	
<b>Material</b>	<b>304-2B Stainless Steel</b>
<b>Thickness</b>	<b>1.5mm / 0.059"</b>
<b>SS Tube Clips</b>	<b>301 Stainless Steel</b>
<b>Bolts, Washers and Nuts</b>	<b>430 Stainless Steel</b>
Insulation	
<b>Material</b>	<b>Compressed Glass Wool</b>
<b>Insulation Factor</b>	<b>K = 0.043W/mK</b>
<b>Max Working Temp</b>	<b>300°C / 577°F</b>

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 <sup>-6</sup> °C
Absorptance (α)	>92% (AM1.5)
Emittance (ε)	<8% (80°C)
Vacuum	P<5x10 <sup>-3</sup> Pa
Stagnation Temperature	>200°C >395°F
Heat Loss	<0.8W/ (m <sup>2</sup> °C)
Maximum Strength	0.8Mpa
Absorber Area per Tube	0.08m <sup>2</sup>
Heat Pipes & Heat Transfer Fins (Heat Transfer)	
Length	1800mm 70.8"
Material	Oxygen Free Copper (TU1) Cu+Ag> 99.99% (O <sub>2</sub> <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 <sup>-3</sup> 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 <sup>2</sup> Zn coating)
Freeze Protection Sleeve	Ø8mm OD x 1mm x 150mm 304-SS
Rubber Components	
Material	HTV Silicone Rubber
Density	1.15 g/cm <sup>3</sup> +/- 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

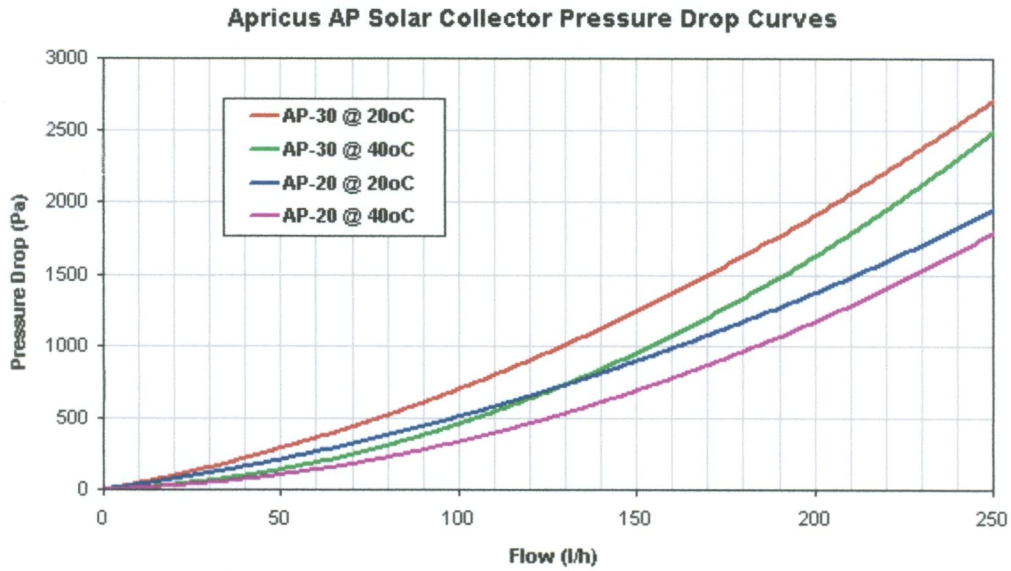
<b>Stagnation</b> SPF Report No. C632LPEN	245°C, when $G = 1000\text{W/m}^2$ , Ambient Temp = 30°C 477°F, when $G = 317\text{Btu/ft}^2$ , Ambient Temp = 86°F									
<b>Efficiency</b> SPF Report No. C632LPEN	$\eta_0 (-) = 0.717$ , $a_1 (\text{W/m}^2\text{K}) = 1.52$ , $a_2 (\text{W/m}^2\text{K}^2) = 0.0085$ $G = 800\text{W/m}^2 / 253\text{Btu/ft}^2$ based on Absorber area.									
<b>Quality Certifications</b>	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)									
<b>Incidence Angle Modifier</b>	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°
<b>K<math>\theta</math> (longitudinal)</b>						0.93				
<b>K<math>\theta</math> (transversal)</b>	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**  
( $G=800\text{W/m}^2$ )



## 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.



## 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 <sub>2</sub> (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
<b>TOTAL</b>					<b>386.7</b>	<b>386.7</b>

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

\*\* Based on 1kg of CO<sub>2</sub> per kWh of energy used.

Approximate values for each model size		
AP-10	128.90	kg of CO <sub>2</sub>
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/m<sup>2</sup>/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.



## Model SH-28

### Four-Chamber Tankless Electric Micro-Boiler

**Description:** The Model SH-28 four-chamber tankless electric space heater is designed for use in residential and commercial hydronic space heating applications such as, but not limited to, radiant floor heating, baseboard, hydro-heat pump and snow melting systems. This new micro-boiler is the ideal replacement for traditional boilers and tank-type heaters and is the enabling technology for use with active renewable energy systems such as solar and geothermal systems. The temperature activated control works effectively in low pressure and re-circulating systems. With optional equipment, the SH-28 can be used as the single heat source in combination systems for potable hot water and space heating. A minimum of 200 AMP whole house electrical service is recommended.

#### Features:

- UL 834 Approval Listing for Space Heating Applications
- Works with tubing and manifold systems
- No minimum flow activation required
- Built-in DSM Utility Integration option
- Compatible with Home Energy Management Systems
- Heats fluid mixtures including ethylene glycol (antifreeze)
- No moving parts
- Very small & compact
- Light weight modular construction
- No restriction to flow
- Standard 3/4 inch plumbing connections
- Microprocessor digital control
- Power sharing & variable power control technology
- Continuous venting
- Heats continuously only when needed, no storage
- Self-diagnostics
- Redundant safety devices
- High performance polymer nylon chamber material
- Built-in Leak detector and alarm
- Rust & corrosion resistant

#### Specifications:

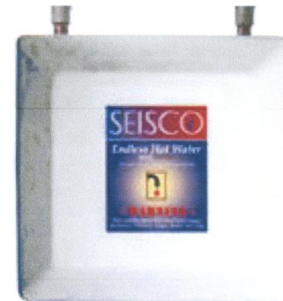
Heat Output (max.): **95,560 BTU**  
 Power Rating (max.): **28KW**  
 Voltage Rating (Nominal): **240 VAC**  
 Current Rating (max.): **116 AMPS**  
 Energy Factor: **0.99+**  
 Heating Elements: **7000 watts x 4**  
 Circuits Required: **Four (4), 2-wire w/ ground\***  
 Breakers Required: **Four (4), double-pole\***  
 Breaker Size: **40 AMPS each x 4\***

\*Optional **two (2), 75 AMP** circuit supply – Check with manufacturer for jumpers that must be installed on control board for this option.

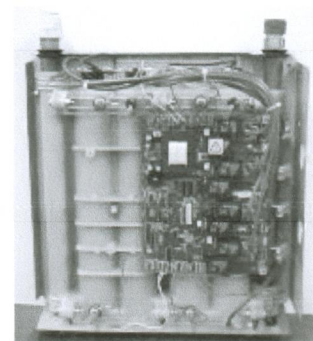
#### Flow Ratings:

Rise (Deg F) @ Flow (GPM)	Rise (Deg C) @ Flow (L/Min.)
95 °F @ 2.0 GPM	50 °C @ 8 L/min
76 °F @ 2.5 GPM	40 °C @ 10 L/min
64 °F @ 3.0 GPM	33 °C @ 12 L/min
48 °F @ 4.0 GPM	25 °C @ 16 L/min

Model SH-28

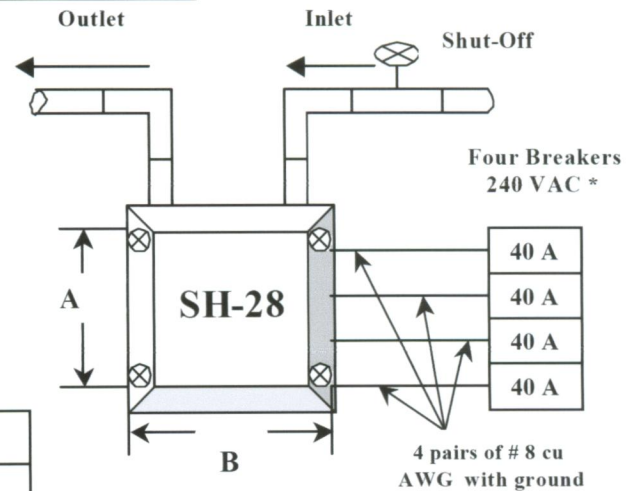


Exterior



Interior

#### INSTALLATION



#### Dimensions:

Weight: **23 lbs (10.4 kg)**  
 Height: **15 3/4" (400 mm)**  
 Width: **15 3/4" (400 mm)**  
 Depth: **6 1/4" (159 mm)**  
 Fittings: **3/4" (200 mm)**

#### Mounting Holes:

"A" Mount: **14 1/4" (362 mm)**  
 "B" Mount: **16 1/8" (410 mm)**

#### Approvals:

U.L. CSA NSF  
 HUD NEC

**Warranty** is for Space Heating Applications only and does not cover use for residential or commercial water heating applications.



# SUNPOWER

## BENEFITS

### High Efficiency

Industry leading panel efficiency of 16.9%

### Attractive Design

Unique design combines high efficiency and an elegant, all-black appearance

### More Power

Delivers up to 50% more power per unit area than conventional solar panels

### Reliable and Robust Design

Proven materials, tempered front glass, and a sturdy anodized frame allow panel to operate reliably in multiple mounting configurations



SPR-210-BLK

## 210 SOLAR PANEL

EXCEPTIONAL EFFICIENCY AND APPEARANCE



10 panels

The SunPower 210 Solar Panel provides a **revolutionary combination of high efficiency and attractive, uniform appearance.** Utilizing 72 next generation SunPower all-back contact solar cells and an all-black backsheet, the SunPower 210 elegantly delivers an unprecedented total panel conversion efficiency of 16.9%. The panel's reduced voltage-temperature coefficient and exceptional low-light performance attributes provide far higher energy delivery per peak power than conventional panels.

**SunPower's High Efficiency Advantage – up to 50% More Power**

Comparable systems covering 25 m <sup>2</sup> / 270 ft <sup>2</sup>		
	Conventional	SunPower
Watts / Panel	165	210
Efficiency	12.0%	16.9%
kWs	3.0	4.2



### Electrical Data

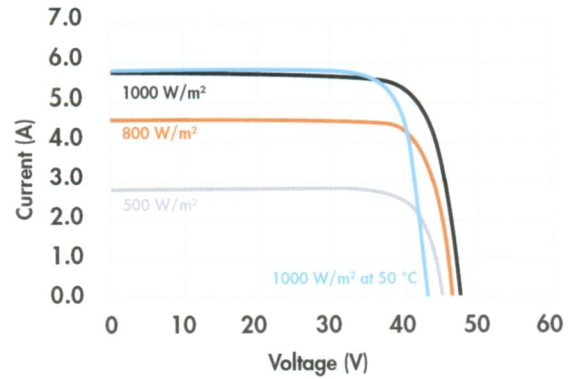
Measured at Standard Test Conditions (STC): irradiance of 1000 W/m<sup>2</sup>, air mass 1.5g, and cell temperature 25° C

Peak Power (+/-5%)	Pmax	210 W
Rated Voltage	Vmp	40.0 V
Rated Current	Imp	5.25 A
Open Circuit Voltage	Voc	47.7 V
Short Circuit Current	Isc	5.75 A
Maximum System Voltage	IEC, UL	1000 V, 600 V
Temperature Coefficients		
	Power	-0.38% /°C
	Voltage (Voc)	-136.8 m V/°C
	Current (Isc)	3.5 m A/°C
Series Fuse Rating		15 A
Peak Power per Unit Area		169 W/m <sup>2</sup> , 15.7 W/ft <sup>2</sup>
CEC PTC Rating		192.9 W

### Mechanical Data

Solar Cells	72 SunPower all-back contact monocrystalline
Front Glass	3.2mm (1/8 in) tempered
Junction Box	IP-65 rated with 3 bypass diodes
Output Cables	900mm length cable / MultiContact connectors
Frame	Anodized aluminum alloy type 6063
Weight	15 kg, 33 lbs

### IV Curve



Current/voltage characteristics with dependence on irradiance and module-temperature.

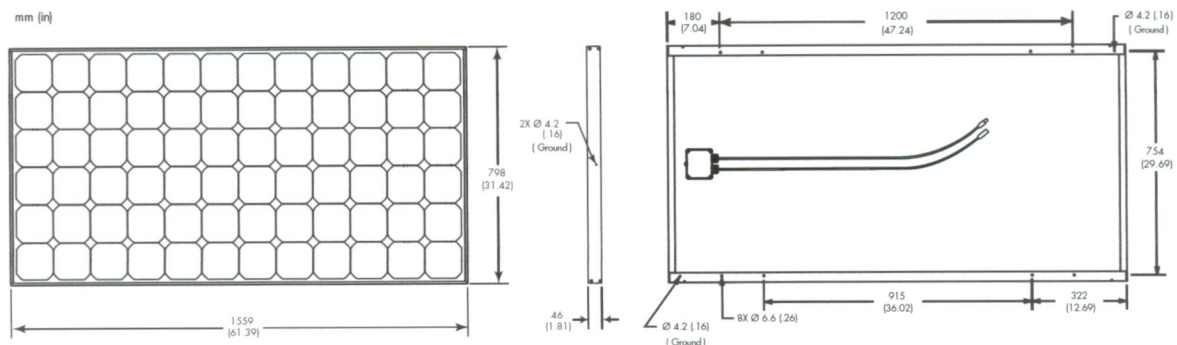
### Tested Operating Conditions

Temperature	-40° C to +90° C (-40° F to +194° F)
Max load	50 psf (2400 pascals) front and back
Impact Resistance	Hail -25mm (1 in) at 23 m/s (52 mph)

### Warranty and Certifications

Warranty	25 year limited power warranty 10 year limited product warranty
Certifications	IEC 61215 , Safety tested IEC 61730; UL listed (UL 1703), Class C Fire Rating

### Dimensions



**CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.** Go to [www.sunpowercorp.com/panels](http://www.sunpowercorp.com/panels) for details

### About SunPower

SunPower designs, manufactures and delivers high-performance solar electric technology worldwide. Our high-efficiency solar cells generate up to 50% more power than conventional solar cells. Our high-performance solar panels, roof tiles and trackers deliver significantly more energy than competing systems.

# SUNPOWER

## BENEFITS

### Reliable and Robust Design

Proven track record for durability and longevity

### High Efficiency

Weighted CEC efficiency over 95% and peak efficiency over 96%

### Reduced Installation Cost

Integrated DC disconnect with fuses lowers material costs and labor requirements

### Attractive Aesthetics

Integrated disconnect eliminates need for visible conduits to inverter

### Ideal Output

Ideal for residential applications



SPR-3000m and SPR-4000m

## 3000m & 4000m INVERTERS

EXCEPTIONAL RELIABILITY AND PERFORMANCE



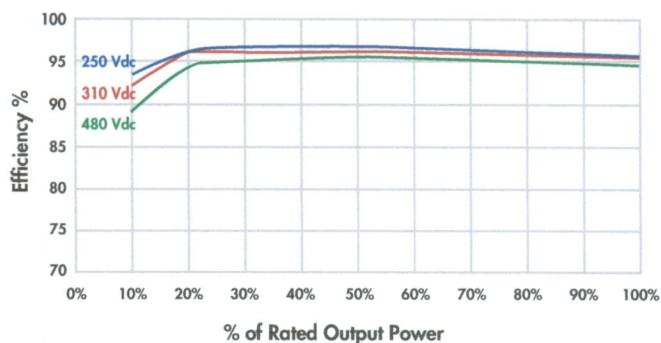
**The SunPower inverters 3000m and 4000m provide exceptional reliability combined with superior performance.** Innovative design and advanced testing have been brought together to create a durable inverter that enables optimal system performance over the long term. Both models come with a standard 10-year warranty.

[www.sunpowercorp.com](http://www.sunpowercorp.com)

#### Electrical Data

	SPR-3000m	SPR-4000m
<b>AC Power</b>	3000 W	3500 W @ 208 V / 4000 W @ 240 V
<b>AC Maximum Output Current (@ 208V, 240V)</b>	15A, 12.5A	17A, 16.6A
<b>AC Nominal Voltage / Range</b>	183 – 229 V @ 208 VAC 211 – 264 V @ 240 VAC	183 – 229 V @ 208 VAC 211 – 264 V @ 240 VAC
<b>AC Frequency / Range</b>	60 Hz / 59.3 Hz – 60.5 Hz	60 Hz / 59.3 Hz – 60.5 Hz
<b>Power Factor</b>	1	1
<b>Peak Inverter Efficiency</b>	96.6%	96.8%
<b>CEC Weighted Efficiency</b>	95.0 % @ 208 V 95.5 % @ 240 V	95.5 % @ 208 V 96.0 % @ 240 V
<b>Recommended Array Input Power (DC @ STC)</b>	3600 W	4800 W
<b>DC Input Voltage Range</b>	200 – 500 V @ 208V 200 – 500 V @ 240V	250 – 600 V @ 208 VAC 250 – 600 V @ 240 VAC
<b>Peak Power Tracking Voltage</b>	180 – 400 V @ 208 VAC 200 – 400 V @ 240 VAC	220 – 480 V @ 208 VAC 250 – 480 V @ 240 VAC
<b>DC Max. Input Current</b>	17 A	18 A
<b>DC Voltage Ripple</b>		< 5%
<b>No. of Fused String Inputs</b>		4
<b>Power Consumption: Standby / Nighttime</b>		< 7 W / 0.1 W
<b>Fused DC Disconnect</b>	Standard; Complies w NEC Standards	
<b>Grounding</b>	Positive Ground	

#### SPRm Efficiency Curves

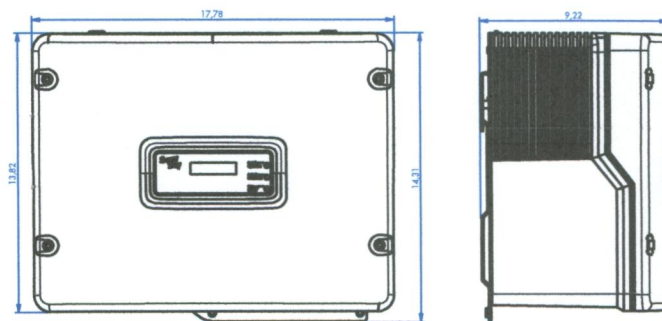


#### Mechanical Data

<b>Shipping Dimensions W x H x D inches</b>	23.5" x 18.5" x 16.0"
<b>Unit Dimensions W x H x D inches</b>	17.8" x 13.8" x 9.3"
<b>Inverter Weight</b>	88 lbs
<b>Shipping Weight</b>	94 lbs
<b>Cooling</b>	Forced Air / Sealed Electronics Enclosure
<b>Enclosure</b>	NEMA 3R
<b>Mounting</b>	Wall Mount Bracket Standard
<b>Ambient Temperature Range</b>	-13 to +113 °F

#### Warranty and Certifications

<b>Warranty</b>	10 year limited warranty
<b>Certifications</b>	Compliance: IEEE-929, IEEE-1547, UL 1741-2005, UL 1998, FCC Part 15 A & B



#### About SunPower

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[www.revisionenergy.com](http://www.revisionenergy.com)

142 Presumpscot Street, Portland, ME 04103

OK to Issue  
Please Mail  
to Revision  
Energy



**CITY OF PORTLAND, MAINE**  
Department of Building Inspections

**Original Receipt**

July 21 2009

Received from Revision Energy

Location of Work 18 victore Rd

Cost of Construction \$ 21,305 Building Fee: \_\_\_\_\_

Permit Fee \$ 230 Site Fee: \_\_\_\_\_

Certificate of Occupancy Fee: \_\_\_\_\_

**Total:** 230<sup>00</sup>

Building (IL) \_\_\_ Plumbing (I5) \_\_\_ Electrical (I2) \_\_\_ Site Plan (U2) \_\_\_

Other \_\_\_\_\_

CBL: \_\_\_\_\_

Check #: 6463 Total Collected \$ 230<sup>00</sup>

**No work is to be started until permit issued.  
Please keep original receipt for your records.**

Taken by: CLM

WHITE - Applicant's Copy  
YELLOW - Office Copy  
PINK - Permit Copy