



SOLAR RATING & CERTIFICATION CORPORATION

**CERTIFIED SOLAR COLLECTOR**

SUPPLIER:  
**Alternate Energy Technologies**  
 1345 Energy Cove Court  
 Green Cove Springs, FL 32043 USA  
 www.aetsolar.com  
 In Accordance with:  
**SRCC Standard 100-2010-08**

BRAND: MorningStar  
 MODEL: MS-21  
 COLLECTOR TYPE: Glazed Flat Plate  
 CERTIFICATION #: 10001956  
 Original Certification: March 30, 2015  
 Expiration Date: December 03, 2024

The solar collector listed below has been evaluated by the Solar Rating & Certification Corporation™ (SRCC™), an ISO/IEC 17065 accredited and EPA recognized Certification Body, in accordance with SRCC OG-100, Operating Guidelines and Minimum Standards for Certifying Solar Collectors, and has been certified by the SRCC. This award of certification is subject to all terms and conditions of the Program Agreement and the documents incorporated therein by reference. This document must be reproduced in its entirety.

COLLECTOR THERMAL PERFORMANCE RATING							
Kilowatt-hours (thermal) Per Panel Per Day				Thousands of Btu Per Panel Per Day			
Climate ->	High Radiation (6.3 kWh/m <sup>2</sup> .day)	Medium Radiation (4.7 kWh/m <sup>2</sup> .day)	Low Radiation (3.1 kWh/m <sup>2</sup> .day)	Climate ->	High Radiation (2000 Btu/ft <sup>2</sup> .day)	Medium Radiation (1500 Btu/ft <sup>2</sup> .day)	Low Radiation (1000 Btu/ft <sup>2</sup> .day)
Category (Ti-Ta)				Category (Ti-Ta)			
A (-5 °C)	8.7	6.6	4.5	A (-9 °F)	29.8	22.6	15.5
B (5 °C)	7.6	5.5	3.4	B (9 °F)	26.1	18.9	11.8
C (20 °C)	6.0	4.0	2.0	C (36 °F)	20.6	13.6	6.7
D (50 °C)	3.0	1.3	0.0	D (90 °F)	10.4	4.3	0.0
E (80 °C)	0.5	0.0	0.0	E (144 °F)	1.8	0.0	0.0

A- Pool Heating (Warm Climate) B- Pool Heating (Cool Climate) C- Water Heating (Warm Climate)  
 D- Space & Water Heating (Cool Climate) E- Commercial Hot Water & Cooling

COLLECTOR SPECIFICATIONS					
<b>Gross Area:</b>	1.997 m <sup>2</sup>	21.50 ft <sup>2</sup>	<b>Dry Weight:</b>	39 kg	86 lb
<b>Net Aperture Area:</b>	1.764 m <sup>2</sup>	18.99 ft <sup>2</sup>	<b>Fluid Capacity:</b>	2.7 liter	0.7 gal
<b>Absorber Area:</b>	1.751 m <sup>2</sup>	18.85 ft <sup>2</sup>	<b>Test Pressure:</b>	1103 kPa	160 psi

TECHNICAL INFORMATION			Tested in accordance with: ISO 9806:1994		
ISO Efficiency Equation [NOTE: Based on gross area and (P)=Ti-Ta]					
<b>SI UNITS:</b>	$\eta = 0.708 - 4.96470(P/G) - 0.01820(P^2/G)$		<b>Y Intercept:</b>	0.713	<b>Slope:</b> -5.892 W/m <sup>2</sup> .°C
<b>IP UNITS:</b>	$\eta = 0.708 - 0.87499(P/G) - 0.00178(P^2/G)$		<b>Y Intercept:</b>	0.713	<b>Slope:</b> -1.038 Btu/hr.ft <sup>2</sup> .°F

Incident Angle Modifier								Test Fluid:	
$\theta$	10	20	30	40	50	60	70	Water	
<b>K<sub>ra</sub></b>	1.00	1.00	0.99	0.97	0.93	0.79		<b>Test Mass Flow Rate:</b>	0.0194 kg/(s m <sup>2</sup> )    14.29 lb/(hr ft <sup>2</sup> )
								<b>Impact Safety Rating: 11</b>	

REMARKS:

*Jean Higgins*

Technical Director

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ADDITIONAL INFORMATION (click here to return to the rating page)			
Test Lab:	Atlas Weathering Services Group	Test Date:	December 03, 2012
Test Report Number:	R2 AT28423	Test Location:	outdoors

SOLAR COLLECTOR CONSTRUCTION DETAILS					
Gross Length:	2.188 m	Gross Width:	0.913 m	Gross Depth:	81.000 mm

COLLECTOR MATERIALS					
Outer Cover:	Glass sheet	Enclosure back:	Aluminum	Back Insulation:	Foam, None
Inner Cover:	None	Enclosure side:	Aluminum	Side Insulation:	Foam, None
Absorber Description:	Tubes connected to Fins		Flow Pattern:	Parallel/Harp	
Riser Tube:	Copper		Fin:	Copper	
Absorber Coating:	Selective		Tube to fin connection	Laser Weld	

GLAZING	Outer Cover	Inner Cover
Material:	Glass sheet	None
Surface Characteristics:	Textured	
Thickness:	3.2 mm	N/A
Transmissivity:	High (equal to or greater than 90%)	
Length:	2.121 m	
Width:	0.842 m	
Tube Glazing to Header Enclosure Seal:	EPDM gasket	

ABSORBER:		Absorber Coating:		Selective	
Header Material:	Copper	Header OD:	28.6 mm	Header Wall:	0.9 mm
Riser Tube Material:	Copper	Riser Tube OD:	10.0 mm	Riser Tube Wall Thickness:	0.6 mm
Fin Material:	Copper	Fin Thickness:	0.20 mm		



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<b>Flow Pattern:</b>	Parallel/Harp				
<b>Number of Riser Tubes:</b>	7	<b>Tube Spacing:</b>	118.7 mm	<b>Number of times each riser crosses the absorber:</b>	1
<b>Length of Flow Path:</b>	2.05 m	<b>Riser to Fin/Plate Bond:</b>	Laser Weld		

INSULATION:					
Location	Type	Thickness	Location	Type	Thickness
<b>Back – Top Layer:</b>	Foam	35.6 mm	<b>Sides – Inner Layer:</b>	Foam	15.9 mm
<b>Back – Bottom Layer:</b>	None		<b>Sides – Outer Layer:</b>	None	
<b>Enclosure Fastening Methods:</b>	Rivets				

Power Output per Collector(W) [ Ti-Ta, G = 1000 W/m² ]					
0	10	30	50	70	
1414	1312	1084	828	542	

PRESSURE DROP					
Flow	ΔP		Flow	ΔP	
ml/s	Pa		gpm	in H <sub>2</sub> O	
20	0		0.32	0.0	
50	0		0.79	0.0	
80	0		1.27	0.0	



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