SOLAR RATING & CERTIFICATION CORPORATION

An ICC Evaluation Service Program

OG-100 Solar Thermal Collector Certification

No./10001934

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CERTIFICATION HOLDER:	EVALUATION SUBJECT	
Alternate Energy Technologies, LLC 1345 Energy Cove Court Green Cove Springs, FL 32043 USA www.aetsolar.com	**BRAND:**	MorningStar
	MODEL:	MSC-21
	TYPE:	Glazed Flat Plate

PRODUCT CERTIFICATION SYSTEM:

The ICC-SRCC OG-100 certification program includes evaluation and performance ratings for solar thermal collectors as established in the *ICC-SRCC Rules for Solar Heating & Cooling Product Listing Reports* The program also includes periodic factory inspections and surveillance of the manufacturer's quality management system.

COMPLIANCE WITH THE FOLLOWING STANDARD(S): *ICC 901/SRCC 100:2020*

OG-100 THERMAL PERFORMANCE RATINGS:

ICC-SRCC OG-100 thermal performance ratings provided for the collector are calculated for a 24-hour period using OG-100 standard conditions using collector parameters measured through laboratory testing. Actual performance will vary with local conditions, installation details and hot water usage.

OG-100 STANDARD DAILY PRODUCTION							
Kilowatt-hours (thermal) Per Panel Per Day				Thousands of Btu Per Panel Per Day			
Climate -> Category (Ti-Ta)	High Radiation (6.3 kWh/m².day)	Medium Radiation (4.7 kWh/m².day)	Low Radiation (3.1 kWh/m².day)	Climate -> Category (Ti-Ta)	High Radiation (2 kBtu/ft².day)	Medium Radiation (1.5 kBtu/ft².day)	Low Radiation (1 kBtu/ft².day)
A (-5 °C)	8.8	6.7	4.6	A (-9 °F)	30.0	22.9	15.7
B (5 °C)	8.0	5.9	3.8	B (9 °F)	27.3	20.1	13.0
C (20 °C)	6.6	4.6	2.5	C (36 °F)	22.5	15.7	8.5
D (50 °C)	3.7	1.9	0.3	D (90 °F)	12.6	6.5	1.0
E (80 °C)	1.1	0.0	0.0	E (144 °F)	3.8	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

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THERMAL EFFICIENCY:

The efficiency of solar thermal collectors is determined using test methods set in ICC 901/SRCC 100, based on ISO 9806 procedures. Results are processed to provide unique coefficients ($\eta_{0,hem}$, a1, a2…) for collection efficiency equations, provided in several forms below. For the simplified equations, instantaneous power is given by $\dot{Q} = \eta_{hem} A_G G$. Incident Angle Modifiers (IAMs) are provided to indicate the change in output as the angle of solar irradiance changes in the transverse and longitudinal planes of the collector. The inputs to the equations are defined as:

T_i: Temperature of the fluid entering the collector

T_a: Temperature of the ambient air around the collector

G: Hemispherical solar irradiance. Sub-types include beam (b) and diffuse (d) irradiance.

A_G: Gross collector area

SIMPLIFIED THERMAL PERFORMANCE COEFFICIENTS (ISO 9806-2013, Ti, AG)					
Second Order Thermal Efficiency Equation* $\eta_{,hem}=\eta_{(0,hem)}-(a_1 (T_i-T_a)/G)-a_2 G((T_i-T_a)/G)^2$				Linearized Thermal Efficiency Equation* $\eta_{,hem}=\eta_{(0,hem)}-a_1 (T_i-T_a)/G$	
UNITS:	**$\eta_{,hem}$**	**a_1**	**a_2**	**$\eta_{,hem}$("Intercept")**	**a_1("Slope")**
SI	0.711	3.603 (W/m².°C)	0.027(W/m².°C)	0.726	5.380 (W/m².°C)
IP	0.711	0.635 (Btu/hr.ft².°F)	0.005 (Btu/hr.ft².°F)	0.726	0.948 (Btu/hr.ft².°F)

* Thermal efficiency equations per ISO 9806-2013 using inlet (Ti) fluid temperature, provided in second and first order (linearized) forms. The second order efficiency equation is a more accurate representation of the collector performance. The linearized efficiency equation is provided for use with incentive programs, regulations and software that require the simplified "slope" and "intercept" coefficients to describe collector performance.

DIRECT INCIDENT ANGLE MODIFIERS (IAM)											
Angle (θ)	θ	0^0	10^0	20^0	30^0	40^0	50^0	60^0	70^0	80^0	90^0
Longitudinal IAM:	**Klα**	1.00	0.99	0.98	0.96	0.90	0.80	0.64	0.45	0.20	0.00
Transverse IAM:	**Krα**	-	-	-	-	-	-	-	-	-	-

TEST SAMPLE SPECIFICATIONS:

The specifications of the collector sample submitted for testing are provided below.

TEST & SAMPLE SPECIFICATIONS					
Gross Area:	2.005 m²	21.58 ft²	**Maximum Design Operating Temperature:**	176.7 °C	350.0 °F
Gross Length:	2.190 m	86.22 in	**Maximum Design Operating Pressure:**	1103.2 kPa	160.0 psi
Gross Width:	0.915 m	36.02 in	**Gross Depth:**	84.1 mm	3.3 in
Test Fluid:	Water		**Dry Weight:**	30.8 kg	68.0 lb
Ave. Flowrate - Thermal Performance Testing:	0.020 Kg/sm^2	0.003 lb/sft^2	**Fluid Capacity:**	2.7 liter	0.7 gal
Test Standard(s):	SRCC 100:2008, ISO 9806:1994				
Notes:					

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IDENTIFICATION:

Certified systems must be identified with the OG-100 certification mark below in accordance with the *Rules for Certification Mark and Certificate Use* and labeled in with the information below per ICC 901/SRCC 100:

1. Manufacturer's name and model number.
2. OG-100 collector certification number.
3. Maximum operating pressure.
4. Dry weight.
5. Fluid volume.
6. Compatible heat transfer fluids.
7. Standard stagnation temperature.
8. Year of manufacture and/or serial number.

CONDITIONS:

The certified solar water heating system must comply with the following conditions:

1. Collector must be installed and operated in accordance with the manufacturer's published instructions and local codes and regulations.
2. OG-100 Standard Performance Ratings and Standard Collector Power Output have been calculated for the tested components using standardized conditions established by the OG-100 program and associated test standards. Actual performance will vary based on the specific usage, installation and local environmental conditions.
3. The collector listed in this ICC-SRCC OG-100 certification must be labeled in accordance with the *Rules for Certification Mark and Certificate Use.*
4. OG-100 certifications do not include mounting hardware and fixtures.
5. Solar thermal collectors and mounting hardware and appurtenances must comply with all applicable local requirements for fire resistance. Solar thermal collectors must be mounted in accordance with the requirements of the collector and mounting hardware manufacturers to comply with local codes for structural loading for wind, seismic, snow and other loads.
6. Solar thermal collectors must be used with the heat transfer fluids listed in this document.
7. Solar thermal collector manufactured under a quality control program subject to periodic evaluation in accordance with the requirements of ICC-SRCC.
8. This document must be reproduced in its entirety.
9. Certification status should be confirmed on the ICC-SRCC Directory at www.solar-rating.org

Vice President of Technical Services, ICC-SRCC

A2LA ACCREDITED
CERTIFICATE # 3299.01, 3299.03

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