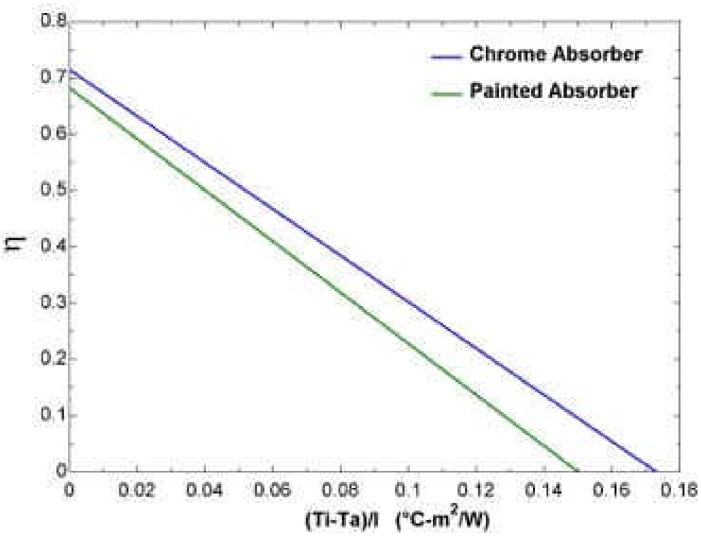
SunEarth inc. Quality Solar Energy Products

SunEarth SRCC OG-100 Collector Ratings

The Solar Rating & Certification Corporation OG-100 rating is an independent assessment of the thermal output of solar collectors. Collectors that receive this rating must undergo a rigorous review performed by SRCC staff that includes 30 days of stagnation testing. Once the collector has passed these quality assurance checks it undergoes a full performance analysis to determine the thermal performance of the unit under a wide range of conditions. Thermal performance is provided as both collector efficiency plots and as daily output summaries for various climates and applications.

Note: All SunEarth flat-plate collectors carry the same SRCC OG-100 ratings as they are identical except for the casing, which does not effect thermal performance. The only difference is the absorber plate type that is placed in the collectors with chrome and painted absorbers carrying two separate ratings.

SRCC Collector Efficiency Plots



Unlike traditional water heaters or boilers that have a fixed output and operating efficiency, both the output and efficiency of solar collectors is dependent on the amount of sunshine and the temperature difference between the collector and the outside air. While the collector is able to absorb a high fraction of the incident solar energy, some of this energy is lost to the colder outside air through convection and radiation through the front cover. The ability of the collector to absorb solar energy and keep it from being lost is described by the Hottel-Whillier efficiency curves on the left. What these curves show is that the greater the temperature difference between the collector inlet water (Ti) and the ambient air (Ta), the lower the operating efficiency due to heat loss. Chrome collectors are sometimes used in colder climates because their operating efficiency is less affected by larger temperature differences. However, in warmer climates this difference may drop to as little as one or two percent, making the added cost of unwarranted.

Example: If we are heating domestic water in Aspen, CO on a clear January day at 10 °F with approximately 700 W/m^2 of sun, and the water going into the collectors is 120 °F, what is the operating efficiency of the array? What is the operating efficiency of the same array on a July day with an ambient temperature of 80°F?

To calculate the efficiency of the array, we must determine the operating point as defined by *(Ti-Ta)/I*. On the January day, the temperature difference *Ti-Ta* is 110°F (120 - 10) or 61°C. Dividing this by the incident solar radiation *I* of 700 W/m^2, we get an operating point of 0.087 °C-m^2/W. Using the efficiency plot above, we see that at this operating point the painted absorber will operate at 29% efficiency while the black-chrome absorber operates at 35%. During the warm July day, the temperature difference drops to 40°F (120 - 80) or 22 °C. The operating point is therefore 0.031 °C-m^2/W. Under these conditions the painted absorber has an operating efficiency of 54%, which is only 3 percent below the operating point of chrome at 57%.

SRCC Collector Daily Output Summaries

Thermal Output (BTU/ft^2-day)

Chrome Absorber

Category (Ti-Ta)	Clear Day	Mildly Cloudy Day	Cloudy Day
A (-9 °F)	1332	1005	680
B (9 °F)	1218	890	565
C (36 °F)	1040	720	402
D (90 °F)	699	405	127
E (144 °F)	390	137	0

Painted Absorber

Category (Ti-Ta)	Clear Day	Mildly Cloudy Day	Cloudy Day
A (-9 °F)	1284	971	659
B (9 °F)	1169	854	542
C (36 °F)	984	677	372
D (90 °F)	619	343	89
E (144 °F)	280	62	0

Electrical Equivalent Output (kWh/ft^2-day)

Chrome Absorber

Category (Ti-Ta)	Clear Day	Mildly Cloudy Day	Cloudy Day
A (-9 °F)	0.390	0.295	0.199
B (9 °F)	0.357	0.261	0.166
C (36 °F)	0.305	0.211	0.118
D (90 °F)	0.205	0.119	0.037
E (144 °F)	0.114	0.040	0.000

Painted Absorber

Category (Ti-Ta)	Clear Day	Mildly Cloudy Day	Cloudy Day
A (-9 °F)	0.376	0.285	0.193
B (9 °F)	0.343	0.250	0.159
C (36 °F)	0.288	0.198	0.109
D (90 °F)	0.181	0.100	0.026
E (144 °F)	0.082	0.018	0.000

Ti - Collector inlet fluid temperature
Ta - Ambient air temperature

Operating Categories

A - Pool Heating (Warm Climate)
B - Pool Heating
C - Water Heating (Warm Climate)
D - Water Heating (Cool Climate)
E - Industrial Process Heat

Operating Days

Clear Day - 2,000 BTU/ft^2
Mildly Cloudy Day - 1,500 BTU/ft^2
Cloudy Day - 1,000 BTU/ft^2

Useful Conversions

3,412 BTU = 1 kWh
100,000 BTU = 1 Therm
8.3 BTU = 1°F Rise per Gallon H_2O

While it would be possible to calculate the instantaneous collector efficiency and therefore output for each hour of the day using the plots given above, such calculations are extremely tedious. Fortunately, the SRCC provides daily outputs of rated collectors for a range of collector operating points listed as the categories above. These categories define the temperate difference Ti-Ta and begin with warm climate pool heating where the collector inlet is actually 9 °F below ambient, and end with the highest temperature application of industrial process heating where the collector operates at 144 °F above ambient. The amount of sun falling on the array, which is needed to determine the operating point, is provided by three typical day types ranging from clear sky days where 2,000 BTU/ft2 fall on the collector aperture down to cloudy days where only 1,000 BTU/ft2 fall on the collector.

To calculate the actual daily output of the collector we first select the operating category that best applies to the application the collector will be installed in. Next we determine the sky type we want to estimate the performance for (clear, mildly cloudy, or cloudy). Depending on whether we want a chrome or painted absorber, we go to the appropriate table and find the intersection of the category and climate type we selected to arrive at the thermal output (or electrical equivalent) per square foot of collector surface area.

Example: What would the thermal output of two 4' x 8' black chrome collectors used for domestic hot water heating be in Aspen, CO during the summer on a clear sky day? Assuming that the collectors are connected to an 80 gallon storage tank starting at 55 °F, what would the tank temperature be at the end of the day?

Although Aspen is typically a cool climate, daytime ambient temperatures can be fairly high in the summer such that the operating category resembles a warm climate. Therefore we'll choose category C to estimate summertime output with a clear day type. Using the thermal output table for chrome absorbers we find that each square foot of collector has a daily output of 1,040 BTU. Therefore, two 4' x 8' collectors with 64 ft^2 of area have a combined output of 66,560 BTU (1,040 x 64). Since it takes 8.3 BTU to raise each gallon of water in the tank by 1 °F ... 66,560 BTU would be able to raise 80 gallons of water from 55 °F up to 155 °F!