



Solar Household Energy, Inc.

Solar Cooking for Human Development and Environmental Relief

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Findings from Solar Cooker Heating Data Comparisons Summer, 2015

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Findings from Solar Cooker Heating Data Comparisons Summer, 2015

The following tables summarize findings based on comparisons of heating curves (temperature vs. time) for pairs of solar cookers that were measured at the same time (that is, under the same solar radiation condition). This report is intended to accompany the earlier report TR-05, "Compilation of Solar Cooker Heating Experiments, 2015" and to provide discussions and findings from these experiments.

All dates are in months/days format. Temperatures are in degrees C. Volumes are in liters.

Date	7/31/2015
Sky	5-15% clouds
Test Item 1	3-liter HotPot with 1 l canola oil
Test Item 2	3-liter HotPot with 1 l canola oil
Findings	The two temperatures are within +/- 2 deg. C about 80% of the time during the day.

Date	8/2/2015
Sky	Thin haze
Test Item 1	3 liter HotPot with 1 liter canola oil
Test Item 2	none
Findings	?

Date	8/3/2015
Sky	Thin haze, got cloudy after 1 hour.
Test Item 1	3-liter HotPot with 1 liter water
Test Item 2	3-liter HotPot with 1 l canola oil
Findings	Compares oil vs. water. Max temp. in oil 140 deg. C

Date	8/6/2015
Sky	5% avg.
Test Item 1	3 L HotPot, sensor touching bottom of pot
Test Item 2	3 L HotPot, sensor above bottom
Findings	The sensor touching the pot changes more rapidly than the one in the liquid. The sensor in the liquid (blue) gradually catches up with the red curve, but it is slower because the liquid retains heat and has a longer time constant.

Date	8/12/2015
Sky	PC; reflectors not turned
Test Item 1	3 L HotPot, 1 L oil
Test Item 2	3 L HotPot, 1 L water
Findings	The oil heated up much faster than the water load. Partly this is due to the lower heat capacity of oil. Also, the water pot produced vapor that scattered some light from the lid, which reduced its light input somewhat. The water did not reach boiling but steamed at a lower temperature.

Date	8/24/2015
Sky	PC
Test Item 1	3 L HotPot, 1 L water
Test Item 2	3 L HotPot, 1 L water
Findings	Temperature differences were up to 11 deg. C. Weather was partly cloudy. There was excessive beading of water on the lid of one of the pots. Flat panels also may add to variability.

Date	8/25/2015
Sky	Clear
Test Item 1	3 L HotPot, 1 L water. Lid carefully cleaned to prevent beading.
Test Item 2	3 L HotPot, 1 L water. Lid carefully cleaned to prevent beading.
Findings	Close agreement, but only 1.4 hours of data.

Date	8/27/2015
Sky	Cirrus; became cloudy later
Test Item 1	3 L HotPot, 1 L tap water. Lid carefully cleaned to prevent beading.
Test Item 2	3 L HotPot, 1 L boiled water. Lid carefully cleaned to prevent beading.
Findings	Pot #1 had slightly more scattering from the lid. Also, the reflectors were shaped somewhat differently; #1 was wider than #2 by 1 inch. Differences of 2.5 deg. C, #2 is higher.

Date	9/1/2015
Sky	PC
Test Item 1	Haines SC #1 with "Dutch Oven" pot, 1 L tap water
Test Item 2	Haines SC #2 with "Dutch Oven" pot, 1 L tap water
Findings	Very repeatable within 1 deg. C

Date	9/3/2015
Sky	Clear to pc, only 115 minutes data
Test Item 1	Haines SC #1 with "Dutch Oven" pot, 1 L tap water
Test Item 2	Haines SC #1 with "Dutch Oven" pot, 1 L tap water
Findings	Good repeatability 2 deg. C

Date	9/7/2015
Sky	Clear
Test Item 1	Haines SC #1 with "Dutch Oven" pot, 1 L tap water
Test Item 2	3 L HotPot #2 with 1 L tap water
Findings	<p>HotPot initially heated faster than Haines, but after 60° the Haines overtook it and proceeded to boiling. Heat loss through gaps!</p> <p>Once it reached boiling, the Haines cooker stayed at that level until the sun angle dropped into shadows at about 4:15 pm.</p> <p>This performance is attributed to the fact that the pot in the Haines cooker has a rubber seal that significantly reduces steam loss and hence heat loss.</p> <p>Another factor is that the HotPot metal liner has a higher mass (581 g) than the Haines pot (368 g).</p> <p>Excellent comparison, except that Haines should have had a slightly larger water load because it has more area.</p>

Date	9/8/2015
Sky	7% pc
Test Item 1	Haines pot & refl. #1, 1 liter tap water, wire thru steam vent
Test Item 2	Haines pot & Morningstar #1 refl., 1 liter tap water, wire over gap.
Findings	The Haines reflector, plus its clear plastic suspension and conical cover, serve to capture more heat from the bottom of the pot and keep it around the pot. Not sure if the plastic sleeve was used with the Morningstar. Repeat.

Date	9/9/2015
Sky	Clear; got cloudy after 2 hours
Test Item 1	Haines with cone
Test Item 2	Haines without cone
Findings	The cone is effective at getting the pot to boiling after 90 minutes; without the cone it never reached boiling, then got cloudy.

Date	9/11/2015
Sky	Clear!
Test Item 1	Haines #1 with 1820 g canola oil
Test Item 2	Hotpot #1 with 1820 g canola oil
Findings	<p>The HotPot stagnation temperature got to 140 deg. C.</p> <p>The Haines stagnation temperature got to only slightly above boiling, 107 deg. C.</p> <p>The HotPot reached 100 C at 50 minutes.</p> <p>The Haines reached 100C at 95 minutes.</p> <p>Note that the HotPot heated faster and to a higher temp. than the Haines.</p> <p>When oil, not water, is used, the comparison is the reverse of the situation with a water load. This implies that the performance of the HotPot is limited by steam pressure, not insulation.</p>

Date	9/14/2015
Sky	Clear; gusty wind
Test Item 1	HotPot 3 L with tape seal
Test Item 2	Ditto
Findings	Both pots boiled in 2 hours. Temp. repeatable within 5° C. This is a classic plot used in the Journal article.

The main conclusion from these experiments is that the HotPot has lid gaps that leak water vapor, reduce efficiency, reduce power, and increase variability from one test to the next. The hot pot lid needs a gasket.