02.11.22

Sweet Heat Reflectors LLC
9019 Oso Ave, Ste C
Chatsworth, CA 91311

INTRODUCTION

360° Product Testing has been retained to perform claim substantiation testing on a supplied reflector / shield product designed for use on outdoor mushroom style patio heaters. For this purpose, (2) Sweet Heat Max reflectors (35" x 15") were provided, pictured at right.

The Sweet Heat MAX reflector is intended to be installed directly onto an outdoor patio heater's top reflector panel.

Claims to be tested or analyzed:

- Blocks "x" % of heat from traveling toward an unwanted direction
- Blocks heat from traveling behind the reflector
- Extends the patio heater range (measured difference w/ & w/o shield in %)
- Saves propane (measured difference w/ & w/o shield in %)
- Pays for itself in propane savings

Test Setup

A Model: YR-100 48K BTU outdoor gas patio heater was supplied to support testing. No branding was found on the heater; however, an ETL Intertek number (5020133) was listed. A housing compartment at the bottom of the unit is designed to store a 20 lb. (4.6 Gallons) propane gas tank. 360° purchased and had filled such a tank.[1]

Figure 1: Supplied YR-100 Outdoor Gas Patio Heater

[1] https://www.lowes.com/pd/BernzOmatic-20-lb-Empty-Propane-Tank/4076498

Upon completing assembly of the patio heater, it was found that the ignitor button was faulty, but the propane regulator and burner were functional. Thus, for all testing purposes the propane gas was ignited via an open flame held in proximity to the burner.[2]

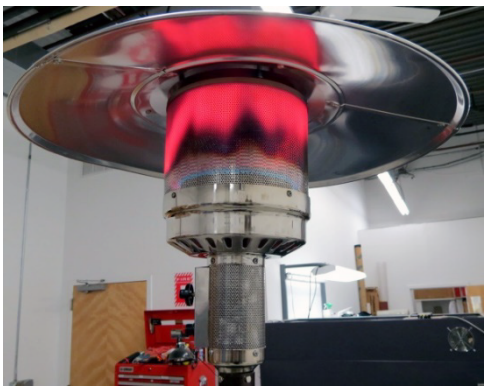

Figure 2: YR-100 on and heating

Effective Heat Travel / Blocked Heat

Effective heat travel testing was guided by a JIS (Japanese Industrial Standards) protocol [3] used to determine efficacy of heating systems (i.e., Patio heater) and to indicate levels of energy output (i.e., BTUs).

Figure 3: Water bottles heating in chamber

Four (4) 1-liter bottles were filled with tap water and then placed into an FTC Systems ATX-30 Temperature Chamber and heated to 68° F (20° C) +/- 5°. An OMEGA Datalogger Thermometer fitted with thermocouples monitored water temperature while heating.

Prior to any testing, the YR-100 heater was powered on and left to stabilize for at least 10-minutes as per operating manual instructions. Testing was performed with the YR-100 set to 100% burner output. After chamber heating and stabilization, a bottle of conditioned water was placed onto a column 48" high and seated directly in line 3.5' away from the heater. The bottle of water under test was left for 10-minutes to heat. Thermocouples monitored and recorded temperature data of the water while under test.

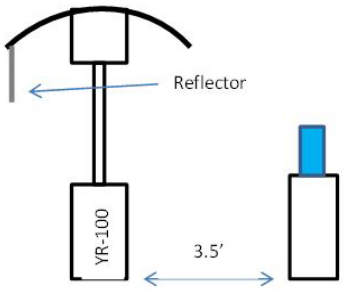

Figure 4: 'Front' test orientation

Two series of measurements were taken, FRONT and REAR. Front measurements were taken with a bottle of water placed directly in line of the heater with and without the reflector unit installed.

The above test was repeated with the heater unit rotated 180° (positions the next set of bottles of water directly behind the reflector), i.e., Rear test orientation.

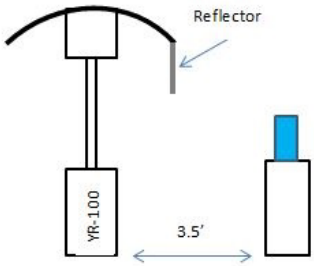

Figure 5: 'Rear' test orientation

[2] Ignition method did not impact testing performance or derived outcomes.

[3] JIS (Japanese Industrial Standards) test is designed to provide a guide to the general efficiency of the heating system and to indicate gross loss of power output based on IEC705 (Microwave Power Test).

Test setup examples are shown below:

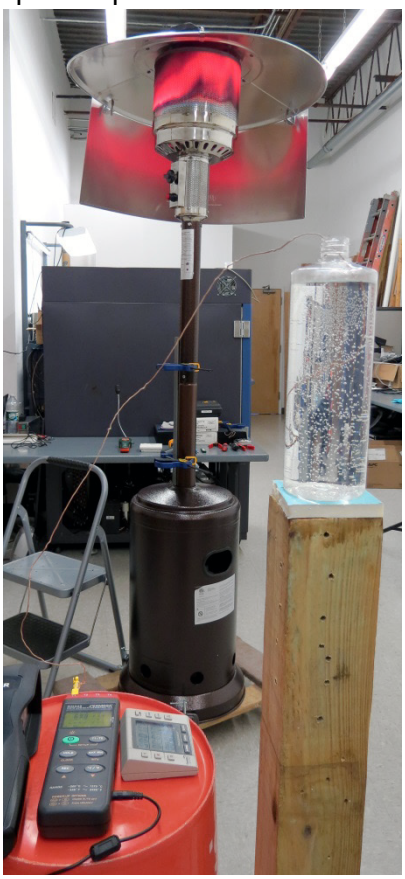

Figure 7: Bottle of water heating directly in front of reflector unit

Figure 6: Bottle of water heating directly behind (rear) reflector unit

Below is the acquired data:

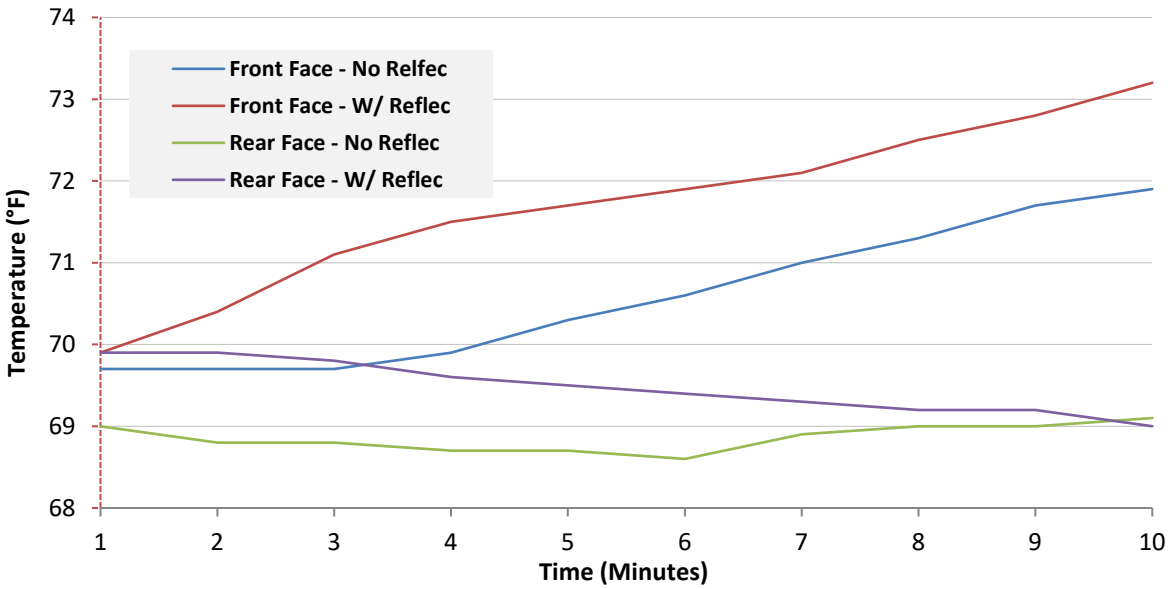

Figure 8: Datalogger data acquired from heated water

Time (Minutes)	FRONT – 3.5 ft Away			REAR – 3.5-ft Away		
	No Reflector	With Reflector	Diff W/ vs W/O Reflector Δ	No Reflector	With Reflector	Diff W/ vs W/O Reflector Δ
Starting (°F)	69.6°	69.5°		69.0°	69.9°	
1 Min	69.7°	69.9°	0.3°	69.0°	69.9°	0.0°
2 Min	69.7°	69.9°	0.3°	68.8°	69.9°	0.2°
4 Min	69.9°	71.5°	1.7°	68.7°	69.6°	0.0°
6 Min	70.6°	71.9°	1.4°	68.6°	69.4°	- 0.1°
8 Min	71.3°	72.5°	1.3°	69.0°	69.2°	- 0.7°
10 Min	71.9°	73.2°	1.4°	69.1°	69.0°	- 0.8°

Figure 9: Water temperatures recorded

As the data above shows, when the bottle of water that was placed in front of the heater with the reflector attached there was a greater temperature rise over a 10-minute period when compared to not having the reflector installed. The reflector demonstrated it had increased heating in front of it.

When the bottle of water was behind the reflector (rear position), the temperature had dropped over the 10-minute period, i.e., decreased 0.9°. Without the reflector the water temperature had increased, i.e., rose 0.1°. The reflector demonstrated it had decreased heating behind it, i.e., it had blocked some heat.

An additional test trial following the JIS protocol was conducted to quantify heat blocked by the reflector. In this outdoor, open-air trial, two equivalently prepared bottles of heated water were simultaneously placed under test. As with the above trial, one bottle was placed behind the reflector 3.5' away. The other was placed beyond the influence of the heater (roughly 16' away). The bottles then were left undisturbed for the 10-minute test period.

The following captured data from the open-air trial quantifies heat blocked by the reflector by comparing an equivalent bottle unaffected by the heater under identical ambient conditions (46°F).

Time	At Ambient	Behind Reflector 3.5'	Diff W/ Reflector vs. Ambient Δ
Starting (°F)	68.0°	69.0°	
After 10 min	65.4°	68.6°	
Δ	2.6°	0.4°	+ 2.2°

As seen in the above data table, the bottle behind the heater cooled roughly 84% less (0.4 / 2.6 = .154) than the bottle at ambient condition. Thus, 15.4% of the heat was blocked by the reflector when placed behind the reflector 3.5-feet away and at a height of 48".

Propane Savings + Calculations

Using the data measured from the bottles placed in **front** of the heater, the energy output of the heater in BTUs can be calculated. Shown below is the measured watt output using the JIS protocol converted into BTUs. (1 Watt = 3.4 BTU).

	100% Burner Output		70% Burner Output
	No Reflector	With Reflector	With Reflector
Starting Temp	69.6°	69.5°	69.8
Ending Temp (after 10 min)	71.9°	73.2°	71.8
Difference	2.3°	3.7°	2.0
Watts JIS	161.0	259.0	140.0
Converted to BTU	547.4	880.6	476.0
Diff W/ vs W/O Reflector %Δ		60.8%	-

Figure 11: Converted heat output to BTUs

As show above with 100% burner output, roughly 61% more heat was transferred with the reflector.

As a no cost courtesy at 360°'s own expense and direction, an additional comparison test was made using a bottle of water heated using 70% burner power with the reflector installed. At 70% output with reflector, measured BTUs were about 13% less than the burner running at 100% output without the reflector.

From the above propane savings can be calculated. The propane tank was first weighed using a precision Mark-10 M5-50 SPEC 2558 force gauge. The gauge was affixed to a metal frame with a chain connected to its end that hooked the propane tank.

After determining its starting weight, the tank was connected back to the YR-100 heater with the Sweet Heat reflector attached. The heater was then operated for 15-minutes at 100% burner output. After 15-minutes the tank was again weighed. The test was then repeated at 70% burner output. Shown below are the results:

	100% Heat Output	70% Heat Output
	With Reflector	With Reflector
Starting weight	26.50 lbs.	25.50 lbs.
Ending weight	25.50 lbs.	25.10 lbs.
Difference: 15 min	1.00 lbs.	0.40 lbs.
Computed Difference: 1 hour	4.00 lbs.	1.60 lbs.

Figure 12: Propane Tank weight results

Figure 10: Weighing propane tank

The following calculations are based on a $25.00 cost to fill a 20-pound propane tank (filled 80% per regulation, or 16-pounds) would be $1.5626 per pound.[4]

[4] 360° purchased 20# of propane for $19.59 on 01.20.22.

In front of the heater, the 70% output with reflector generates roughly 87% of the heat generated at 100% output without the reflector. Thus, for a similar amount of heat (technically, 13% less) the following savings calculation would apply:

- At 100% Burner output = 4.00 x 1.5625 = $6.25 per hour.
- At 70% Burner output = 1.60 x 1.5625 = $2.50 per hour.
- $6.25 - $2.50 = $3.75 savings per hour.

Lowering the burner output to from 100% to 70% saves $3.75 per hour of consumed propane.

The following compares total heat generation in front of the heater measured in BTUs based on minutes of operation at 100% output:

- Burner **with** reflector output for 60-mins = 60 x .0667 [5] x 1.5625 = $ 6.25
- Burner **without** reflector output for 96-mins [6] = 96 x .0667 x 1.5625 = $10.00
- $10.00 - $6.25 = $3.75 savings per adjusted hour.

Generating equivalent BTUs at 100% of heater output in front of the heater using the reflector equates to a consumed propane cost savings of $3.75 per adjusted hour.

The following computes the operating savings of similar heating, in-front of heater at 100% output and no-reflector versus 70% output with-reflector, needed for the savings to equal the retail cost of a Sweet Heat MAX reflector.

- Purchase cost of Sweet Heat MAX reflector = $57.99 [7]
- 57.99 ÷ 3.75 = 15.464
- **Propane savings will pay for a Sweet Heat reflector in ~15.5 hrs.**

The above computation remains the same for equivalent BTU generation at 100% output with and without reflector.

https://www.nbc15.com/2021/10/01/filling-your-propane-tank-could-empty-your-wallet-this-year ($1.566)

[5] 100% output **with reflector** for 60 mins. consumes 4.00 lbs. of propane, or 0.0667 #/min.

[6] 547.4 BTUs at 100% **no-reflector** / 10 mins., (5,283.6 BTUs 96 mins).
880.6 BTUs at 100% **with reflector** / 10 mins., (5,283.6 BTUs 60 mins).

[7] https://sweetheatreflectors.com/products/sweet-heat-reflector-max ($57.99)

Heater Distance / Range

Heating range in front of the heater with and without the reflector installed in the back of the heater was measured using a 12-ft long corrugated plastic (an insulated material that retains heat) sheet strip placed on the floor. To establish a baseline before heating, the plastic's temperature was first measured in 1-foot increments from the heater using a Fluke® 568 IR Thermometer.

As with previous testing, the YR-100 was then turned on and allowed 10-minutes to stabilize before going under test. Following the stabilization period, the plastic testbed was placed directly in front of the heater and allowed to heat for 10-minutes at 100% burner output. After 10-minutes, IR measurements of the plastic were again taken. This process was followed with and without a reflector attached behind the heater (see Figure 13).

Measurements are shown below:

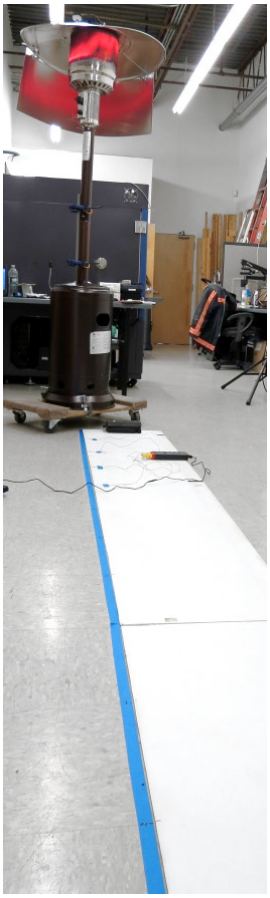

Figure 13: Corrugated plastic sheet being heated

Figure 14: Measuring ambient temperature of plastic sheet

Distance from Heater	Ambient [8]	**Without** reflector	% Δ from Ambient	**With** Reflector	% Δ from Ambient	% Δ Difference from Ambient W/ vs. W/Out **Reflector**
1-ft	57.2°	72.4°	26%	72.7°	27%	+1%
2-ft	57.1°	68.5°	20%	70.5°	23%	+3%
3-ft	56.5°	67.0°	19%	71.3°	26%	+7%
4-ft	56.4°	64.0°	13%	71.4°	26%	+13%
5-ft	55.7°	61.2°	10%	70.3°	26%	+16%
6-ft	54.9°	58.8°	7%	67.3°	22%	+15%
7-ft	54.6°	56.3°	3%	65.5°	20%	+17%
8-ft	53.3°	52.8°	-1%	60.2°	13%	+14%
9-ft	53.2°	*xxx*		60.4°	13%	-
10-ft	53.5°	*xxx*		57.4°	7%	-
11-ft	53.1°	*xxx*		55.6°	6%	-
12-ft	53.4°	*xxx*		53.6°	0.3%	-

[8] Ambient temperatures listed are average temperatures recorded

As seen from the data table, the effective forward distance / range of the heater is roughly 7-feet (84-inches) without aid of a reflector, and 12-feet (144-inches) with the reflector installed. This equates to a 71.4% increase in distance / range when the reflector was installed. With the reflector, higher heat levels were also observed on the plastic at comparable distances.

Conclusions

Based on the testing claims to be analyzed, it was found that the Sweet Heat Reflector / Shield unit(s):

- Blocks "x"% of heat from traveling toward an unwanted direction
- Blocks heat from traveling behind the reflector
    - 15.4% of the heat was blocked by the Sweet Heat MAX Reflector when placed behind the reflector 3.5-feet away and at a height of 48".

- Extends the patio heater range (measured difference w/ & w/o shield in %)
    - The effective forward distance / range of the tested heater is roughly 7-feet (84-inches) without aid of a Sweet Heat MAX Reflector, and 12-feet (144-inches) with the reflector installed. This equates to a 71.4% increase in distance / range when the reflector was installed. Higher heat levels were also observed on the plastic at comparable distances with the reflector.

- Saves Propane (measured difference w/ & w/o shield in %)
    - The tested YR-100 heater delivers similar forward heat (technically, 13% less) with the Sweet Heat MAX Reflector @ 70% burner output as it does with 100% burner output without the reflector, and it consumes 60% less propane (4-pound vs, 1.6 pound per hour).

- Pays for itself in propane savings
    - The $57.99 cost of the Sweet Heat MAX Reflector is effectively paid for in savings after ~15.5 hours of operation. The tested YR-100 heater delivers similar forward heat with reflector @ 70% burner output as it does with 100% burner output without the reflector, which was found to save $3.75 in propane per hour at $25 per tank fill.