Infratech, Model W-3024
Patio Heater Performance Test

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Acknowledgments

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Specific appreciation is extended to Infratech, for supplying the Food Service Technology Center with the W-3024 patio heater for controlled testing in the appliance laboratory.

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Background

Patio heaters are gaining popularity with food service operators as an effective method of extending the outdoor dining season. A deck or patio with added warmth can be operational earlier in the spring and later into the autumn by providing additional heat to an area that would otherwise be unpleasantly cold. A patio heater can also take the edge off a cool summer night to help keep customers comfortable and relaxed.

Also known as space heaters, their conceivable applications extend well beyond the realm of food service into nearly any situation requiring additional heat. There are countless outdoor, as well as many indoor, uses for patio heaters when people or objects require warmth that is otherwise not available.

Infratech has developed a custom quartz element for use in its Infratube™ line of heaters. This element is used in heaters of various sizes and wattages to suit a wide range of applications. The Infratube™ heaters can either be wall mounted or suspended above the area to be heated, which provides great placement flexibility.

While initial capital cost is a determining factor in the selection of a new patio heater, the appliance can also be evaluated with regards to long-term operational cost and performance as characterized by preheat time, energy consumption, and effective heated area.

The Food Service Technology Center (FSTC), operated by Fisher-Nickel, Incorporated, developed a standard testing procedure to evaluate the performance of gas and electric patio heaters. This test procedure was designed to allow evaluation of patio heater performance and energy consumption in a structured laboratory setting.[1]

Infratech W-3024 Patio Heater Performance Testing

Objectives

The objective of this report is to examine the operation and performance of the Infratech Infratube™ electric patio heater, model W-3024, under the controlled conditions of the FSTC Test Method. The scope of this testing is as follows:

1. Energy input rate is determined to confirm that the heater is operating within 5% of the nameplate energy input rate.
2. Preheat energy and time are determined.
3. The temperature distribution and effective heated area is determined with the heater operating at full output.
4. The heater's heating index is determined to relate the input rate to the effective heated area.

Appliance Description

The Infratech Infratube™ heater, model W-3024, is an electric patio heater with an input rate of 3.0 kW at 240 Volts. Heat is generated by a custom quartz element, which is mounted in an anodized reflector. The heater measures 61 ¼ inches long, 8 inches wide and 3 inches deep. The W-3024 can be mounted on a wall or ceiling, or suspended from overhead.

Appliance specifications are listed in Table 1, and the manufacturer's literature is included in Appendix B.

Table 1. Appliance Specifications.

Manufacturer	Infratech
Model	W-3024
Generic Appliance Type	Patio Heater
Rated Energy Input Rate	3.0 kW
Technology	Custom quartz element
Construction	Painted Aluminum Exterior Anodized Aluminium Reflector
Controls	None
Dimensions	61 ¼" Wide × 8" Wide × 3" Deep

Setup and Instrumentation

The W-3024 heater was installed in accordance with the manufacturer's instructions and Section 9 of the FSTC test method.[1] The heater was suspended above the floor at a height of 8 feet, as measured from the lowest point of the face of the heater. The heater was positioned in a flat horizontal position, with the heater as close as parallel to the floor as possible.

Power and energy were measured with a watt/watt-hour transducer that generated a pulse for each 10 Wh used. Heater temperature was monitored with a 24 gauge, type K, fiberglass insulated thermocouple wire which was tack welded to the geometric center of the heater's metal element guard. A grid of 60 globe thermometers with a spacing of 2 feet was used to measure the radiant heat from the heater, and four 24 gauge, type K, teflon insulated, aspirated thermocouples monitored the ambient temperature. The globe thermometers were positioned 36 inches off the floor, to approximate the position of the center of a sitting person's chest. The transducer and all thermocouples were connected to a computerized data acquisition unit that recorded data every 10 seconds. Figure 2-1 shows the design of a single globe thermometer, and Figure 2-2 shows the globe thermometer grid.

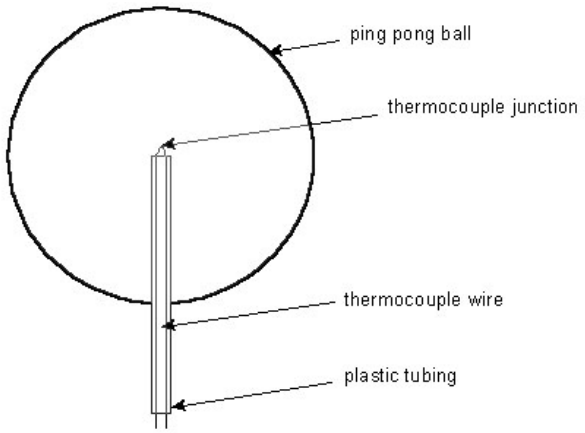

Figure 1.
Globe thermometer design.

Figure 2.
Globe thermometer grid.

Test Procedure and Results

Energy Input Rate

The energy input rate was determined by turning the heater on and measuring the energy consumed for a period of 15 minutes. The energy used and the time elapsed were used to calculate the maximum energy input rate. The energy input rate was calculated at 3.1 kW, which was within 3.2% of the nameplate rate of 3.0 kW. This ensured the heater was operating as per the manufacturer's specification, and testing could continue without adjustment.

Preheat Test

The preheat test recorded the time and energy required for the heater to increase the reflector temperature from 75 ± 5°F to a temperature that equals 95% of the heater's maximum stabilized temperature (as measured at the center of the element guard). Recording began when the heater was first turned on, so any time delay before the energizing of the elements was included in the test. The test was completed when the heater temperature had

stabilized to within ±3°F over a period of 5 minutes. The end of the preheat test was determined to be the time when the heater temperature had reached 95% of its maximum temperature. The elapsed time and the energy consumed by the heater up until this point was reported as preheat time and energy.

The preheat test indicated a maximum element guard temperature of 182.2°F, which meant the heater was considered preheated when the guard reached 173.5°F (95% of maximum). The heater reached this temperature in 9.2 minutes, while consuming 480 watt-hours of energy. The preheat chart for the Infratech W-3024 is shown in Figure 3.

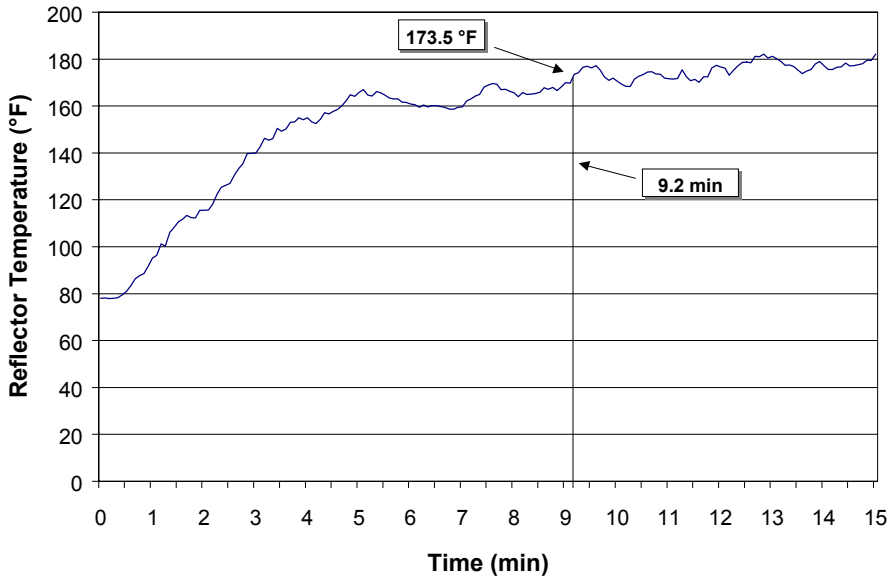

Figure 3.
Preheat characteristics.

Table 2 summarizes the results of the input and preheat tests for the Infratech W-3024 heater.

Table 2. Input and Preheat Test Results.

Rated Energy Input Rate (kW)	3.0
Measured Energy Input Rate (kW)	3.1
Percentage Difference From Rated (%)	3.2
Preheat	
Time (min)	9.2
Energy (Wh)	480

Temperature Distribution and Effective Heated Area

Temperature distribution and effective heated area tests are used to determine the specific boundary where the heater has raised the mean radiant temperature of the globe thermometers to 3°F above the design temperature of 60°F. With this information, the size and shape of the heat pattern can be determined and the heater's heating index can be calculated.

To ensure that all test apparatus was in a stable condition, the temperatures of the globe thermometers and the heater reflector were monitored for a period of 5 minutes before the heater was turned on. Each temperature was verified to be stable to within ± 0.5° F during this period, indicating the test cell was not in a transitional state of heating up or cooling down. The heater was then turned on and allowed to run for 15 minutes, after which time the globe thermometer temperatures were recorded for 5 minutes.

In order to generate the plot, each average globe thermometer temperature from the 5 minute test was first normalized to the design mean radiant temperature. The average normalized temperature of each globe thermometer location is shown in Figure 3-2.

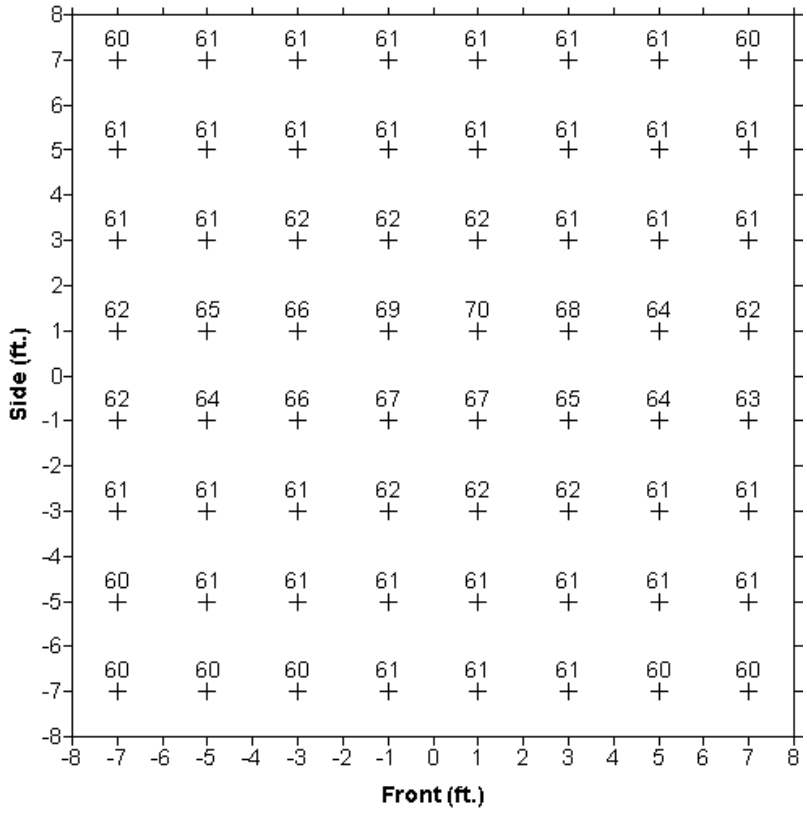

Figure 4.
Average normalized globe thermometer temperatures.

To determine the exact location of the distribution plot boundary, the linear interpolation procedure described in the FSTC Test Method is applied to the areas of the mean radiant temperature chart where one globe is above the threshold temperature and an adjacent globe is below it. The distribution plot for the Infratech W-3024 heater, shown in Figure 3-3, includes the 63°F temperature boundary specified by the test method, as well as additional boundaries indicating further temperature rises in increments of 2°F.

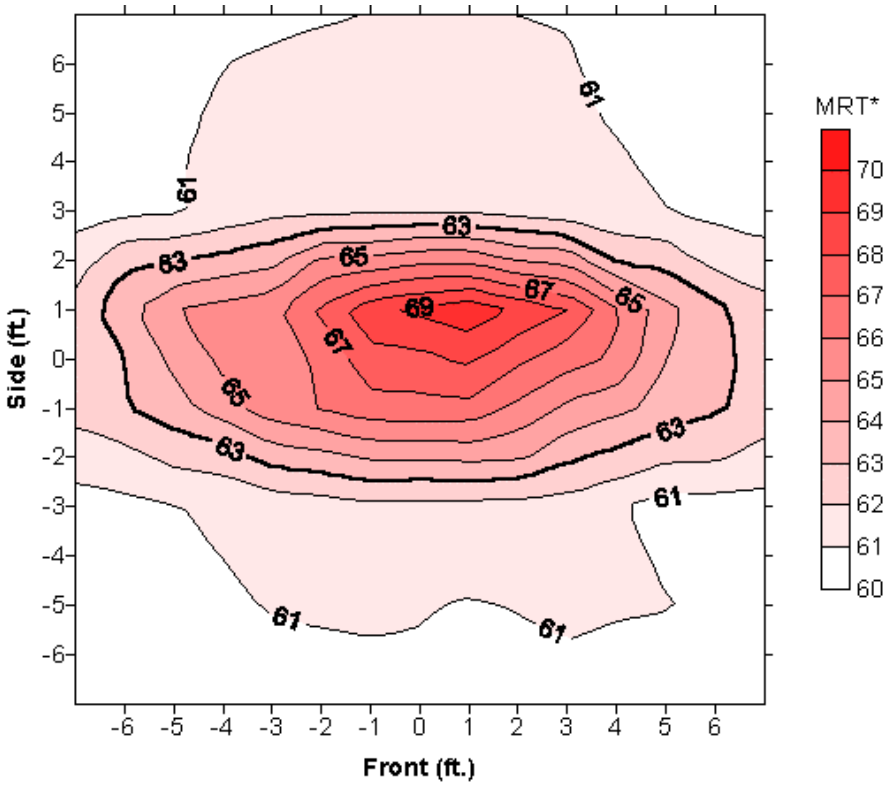

Figure 5. Temperature distribution plot.

The effective heated area is the area contained within the boundary of the 63°F contour line shown in the temperature distribution plot. The heated area for the Infratech heater was 51.1 ± 4.3ft^2.

Figure 6 characterizes the radiant heat distribution of the W-3024 heater by showing the average front to back and left to right temperatures across the test grid.

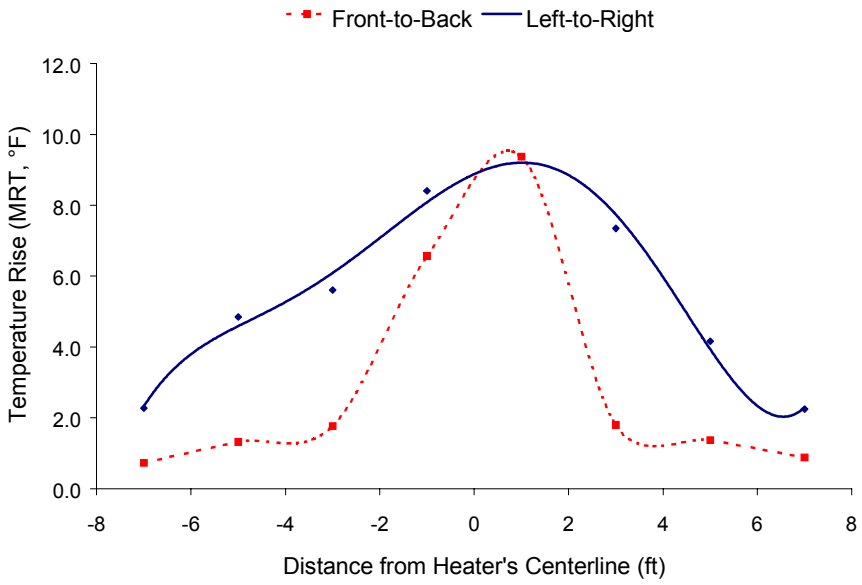

Figure 6. Radiant heat distribution.

Heating Index

The heating index relates the effective heated area to how much energy is consumed by the patio heater in one hour. It is calculated by dividing the effective heated area by the patio heater input rate. The heating index was 16.5 ft^2/kW for the W-3024 heater.

Conclusions

The Infratech W-3024 patio heater is the larger of two Infratube™ heater models tested at the Food Service Technology Center[2]. While the design and technology is the same for both heaters, the W-3024 has a higher input of 3.0 kW and a longer profile for more intensive applications.

The W-3024 heater produced an oblong shaped temperature distribution with an effective heated area of 51.1 ± 4.3 ft^2. The effective heated area represents the part of the test cell raised to at least 3°F above the ambient design environment, but as the mean radiant globe temperature and temperature distribution plots show, a maximum temperature of 70°F was realized underneath the heater— a full 10°F above the design environment.

Since no one heater can be a perfect fit for every installation, the food service operator is best served by choosing a patio heater that will best meet their particular needs. In that regard, the Infratech W-3024 is well suited to applications requiring an overhead mounted, low profile electric patio heater.

References

1. Food Service Technology Center. 2002. *FSTC Test Method for the Performance of Patio Heaters.* #025-02, Version 6.2.

2. Sorensen, G. Publication Pending. Infratech, Model W-2024 Patio Heater Performance Test. Food Service Technology Center.

A Glossary

Design Environment

Unheated environment for which test unit's performance is to be evaluated. Design environment is specified as having a mean radiant temperature of 60°F.

Effective Heated Area (ft^2)

The amount of square footage under a patio heater that can be warmed to a specified temperature (3°F above the design environment).

Energy Input Rate (kW or kBtu/h)
Energy Consumption Rate
Energy Rate

The peak rate at which an appliance will consume energy, typically reflected during preheat.

Heating Index (ft^2/kW)

The quotient of the measured energy input rate and the effective heated area.

Heating Value (Btu/ft^3)
Heating Content

The quantity of heat (energy) generated by the combustion of fuel. For natural gas, this quantity varies depending on the constituents of the gas.

Measured Input Rate (kW or Btu/h)
Measured Energy Input Rate
Measured Peak Energy Input Rate

The maximum or peak rate at which an appliance consumes energy, typically reflected during the initial appliance draw-down or cool-down period (i.e., the period of operation when the compressor(s) are "on").

Mean Radiant Temperature (°F)

The uniform surface temperature of an imaginary black enclosure in which an occupant would exchange the same amount of radiant heat as in the actual non-uniform space.

Rated Energy Input Rate
(kW, W or Btu/h, Btu/h)
Input Rating (ANSI definition)
Nameplate Energy Input Rate
Rated Input

The maximum or peak rate at which an appliance consumes energy as rated by the manufacturer and specified on the nameplate.

Pilot Energy Rate (kBtu/h)
Pilot Energy Consumption Rate

The rate of energy consumption by the standing or constant pilot while the appliance is not being operated (i.e., when the thermostat(s) or control knob(s) have been turned off by the operator).

Preheat Energy (kWh or Btu)
Preheat Energy Consumption

The total amount of energy consumed by an appliance during the preheat time.

Preheat Time (min)
Preheat Period

The time required for an appliance to "preheat" from the ambient room temperature (75 ± 5°F) to a specified (and calibrated) operating temperature or thermostat set point.

Test Method

A definitive procedure for the identification, measurement, and evaluation of one or more qualities, characteristics, or properties of a material, product, system, or service that produces a test result.

B Manufacturer's Specifications

Appendix B includes the product literature for the Infratech patio heater, Model W-3024.

INFRATUBE™

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Infrared Radiant Heaters Item List & Specifications

Powder Coated Fixtures (Beige)

Part No.	Description	Length	BTUs	Watts	Volts	Amps	Ship Wt.
22-1040	W-1512 Fixture	33”	5,118	1,500	120	12.5	12
22-1045	W-1524 Fixture	33”	5,118	1,500	240	6.3	12
22-1055	W-2024 Fixture	39”	6,824	2,000	240	8.4	13
22-1100	W-3024 Fixture	61¼”	10,236	3,000	240	12.5	20
22-1125	W-4024 Fixture	61¼”	13,648	4,000	240	16.7	20

Dual-Element Powder Coated Fixtures (Beige)

Part No.	Description	Length	BTUs	Watts	Volts	Amps	Ship Wt.
22-2100	WD-4024 Fixture	39”	13,648	4,000	240	16.7	14
22-2200	WD-5024 Fixture	39”	17,060	5,000	240	20.8	14
22-2300	WD-6024 Fixture	61¼””	20,472	6,000	240	25	22
22-2400	WD-8024 Fixture	61¼”	27,296	8,000	240	33.4	22

Stainless Steel Fixtures

Part No.	Description	Length	BTUs	Watts	Volts	Amps	Ship Wt.
21-1040	W-1512-SS Fixture	33”	5,118	1,500	120	12.5	12
21-1045	W-1524-SS Fixture	33”	5,118	1,500	240	6.3	12
21-1055	W-2024-SS Fixture	39”	6,824	2,000	240	8.4	13
21-1100	W-3024-SS Fixture	61¼”	10,236	3,000	240	12.5	20
21-1125	W-4024-SS Fixture	61¼”	13,648	4,000	240	16.7	20

Dual Element Stainless Steel Fixtures

Part No.	Description	Length	BTUs	Watts	Volts	Amps	Ship Wt.
21-2100	WD-4024-SS Fixture	39”	13,648	4,000	240	16.7	14
21-2200	WD-5024-SS Fixture	39”	17,060	5,000	240	20.8	14
21-2300	WD-6024-SS Fixture	61¼””	20,472	6,000	240	25	22
21-2400	WD-8024-SS Fixture	61¼”	27,296	8,000	240	33.4	22

Parts and Accessories

Part #	Model #	Description	Ship Wt.
10-1065	E-1512 Element	E-1512 Element Fits WD & W-1512 Heater	6
10-1070	E-1524 Element	E-1524 Element Fits WD & W-1524 Heater	6
10-1085	E-2024 Element	E-2024 Element Fits WD & W-2024 Heater	8
10-2030	E-3024 Element	E-3024 Element Fits WD & W-3024 Heater	11
10-2055	E-4024 Element	E-4024 Element Fits WD & W-4024 Heater	11
13-1260	Wall Mount	Wall Mounting Bracket	3
14-4092	INF-10 (120V)	Variable Intensity Control	2
14-4094	INF-20 (240V)	Variable Intensity Control	2
22-1250	Pole Mount	Freestanding Heater Mount	60
22-1260	Pole Mount w/INF Box	Freestanding Heater Mount	62
18-2300	W-20 Special Mount	Flush Plaster Ceiling Mount	18
18-2305	W-30 Special Mount	Flush Plaster Ceiling Mount	21
18-2310	W-20 Special Mount	Flush T-Bar Ceiling Mount	18
18-2315	W-30 Special Mount	Flush T-Bar Ceiling Mount	21
30-4000	CH-50 Control	50 Amp Intensity Control	10
30-4010	CH-300 Control	50 Amp 3-Zone Control	30
30-4020	CH-100-IR	50 Amp 1-Zone Control w/IR Thermocouple Control	30

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C Results Reporting Sheets

Manufacturer Infratech

Model W-3024

Date: July, 2002

Test Patio Heater:

Description of operational characteristics: Single quartz tube element electric patio heater. Operates at 240V.

Apparatus:

The heater was installed in a 20 by 20-foot space at a height of 8-feet above the floor.

An array of 60 globe thermometers was arranged beneath the heater at a height of 36-inches above the floor to monitor mean radiant temperature. The globes in the array were spaced 24-inches apart, making a 15 by 15-foot test grid. Each of the four quadrants contained an aspirated thermocouple at a height of 36-inches above the floor for measuring ambient air temperature (see Figure 1).

Power and energy were measured with a Watt/Watt-hour transducer that generated an analog signal for instantaneous power and a pulse for every 10 Wh. The transducer and thermocouples were connected to an automated data acquisition unit that recorded data every 5 seconds. A voltage regulator was connected to the patio heater to maintain a constant voltage for all tests.

Figure 1. Globe thermometer array.

Energy Input Rate:

Test Voltage	240 V
Measured	3.1 kW
Rated	3.0 kW
Percent Difference between Measured and Rated	3.3 %

Preheat:

Test Voltage	240 V
Preheat Time	9.2 min.
Preheat Energy	480 Wh

Mean Radiant Temperature Distribution:

Figures 1 through 3 show the normalized mean radiant temperature for each globe location with the heater operating at maximum input. Figure 4 shows front-to-back and left-to-right temperature distributions for the Infratech 3 kW heater.

Results Reporting Sheets

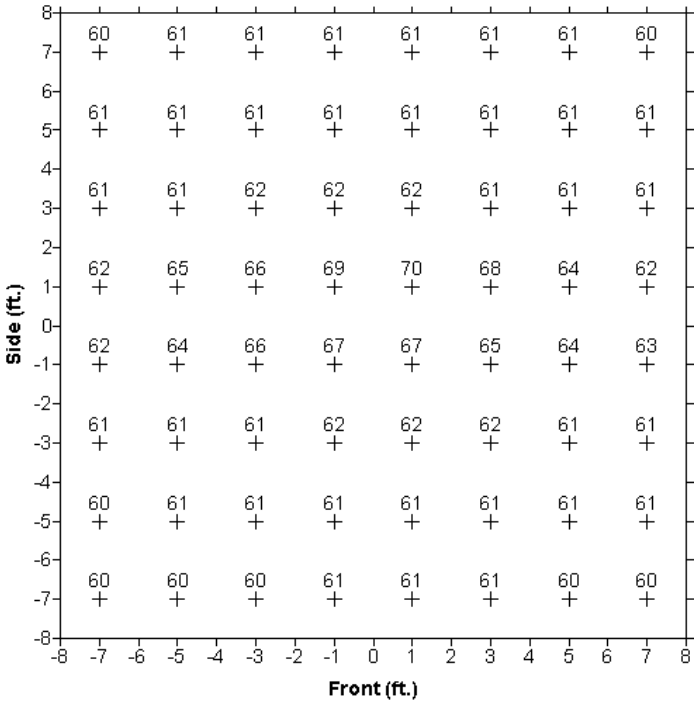


Figure 2. Test #1 normalized mean radiant temperatures.

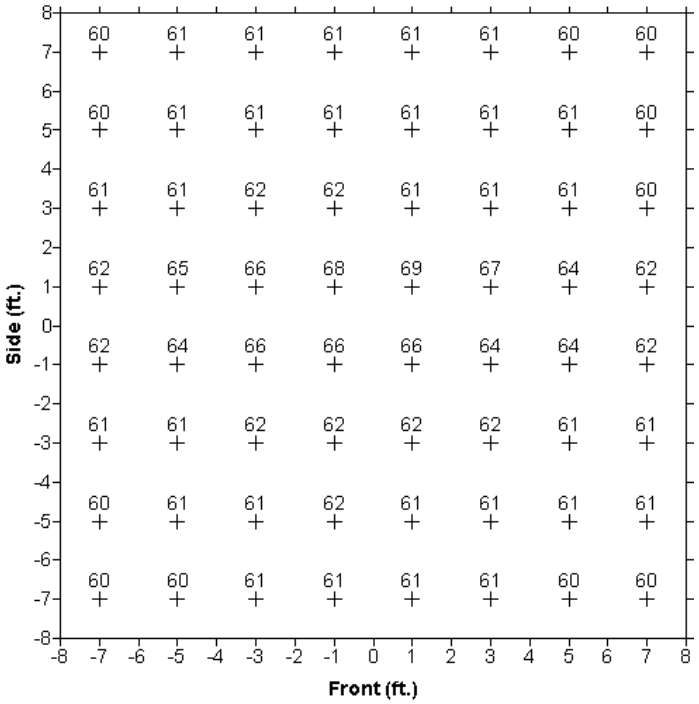


Figure 3. Test #2 normalized mean radiant temperatures.

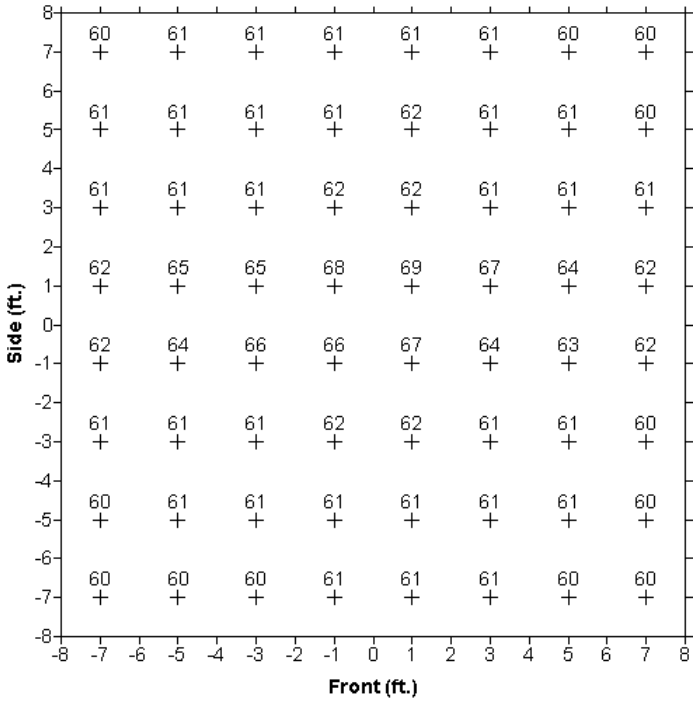


Figure 4. Test #3 normalized mean radiant temperatures.

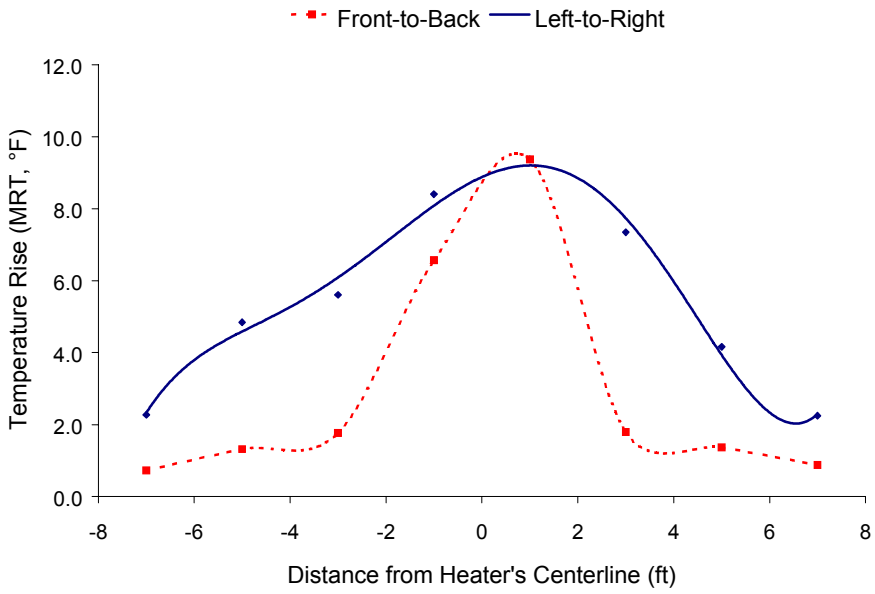
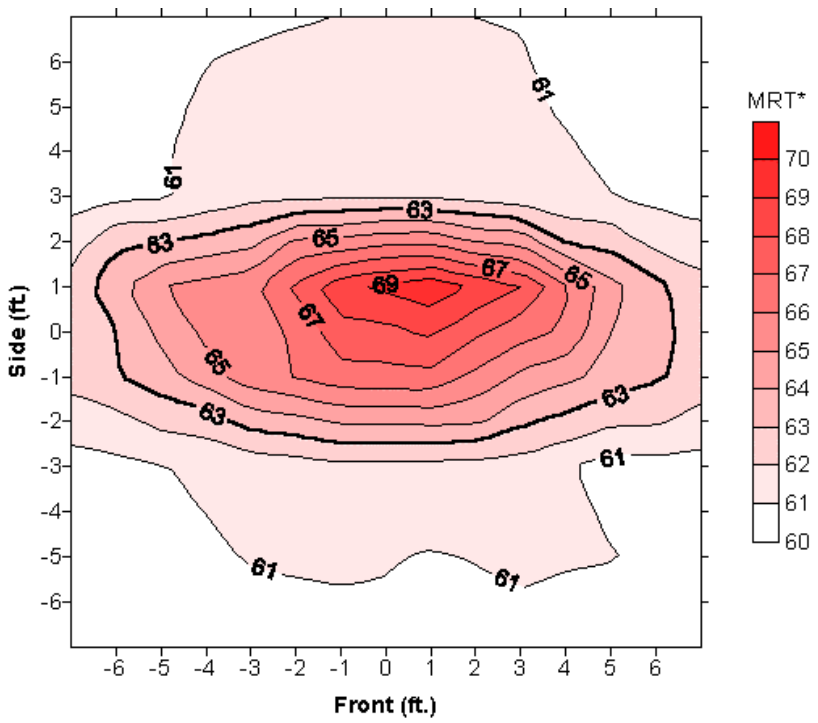


Figure 5. Radiant heat distribution.

Effective Heated Area:

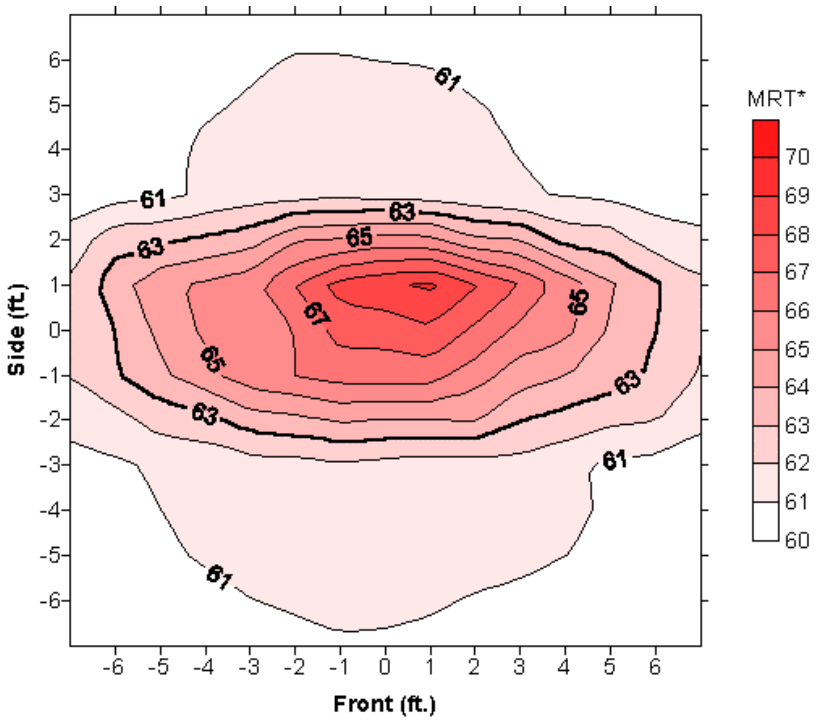
The effective heated area is defined as the area under the heater with a normalized mean radiant temperature of 63°F and higher. The resulting thermal plots for the three tests are shown in Figures 5 through 7.

Effective Heated Area	51.1 ± 4.3 sqf



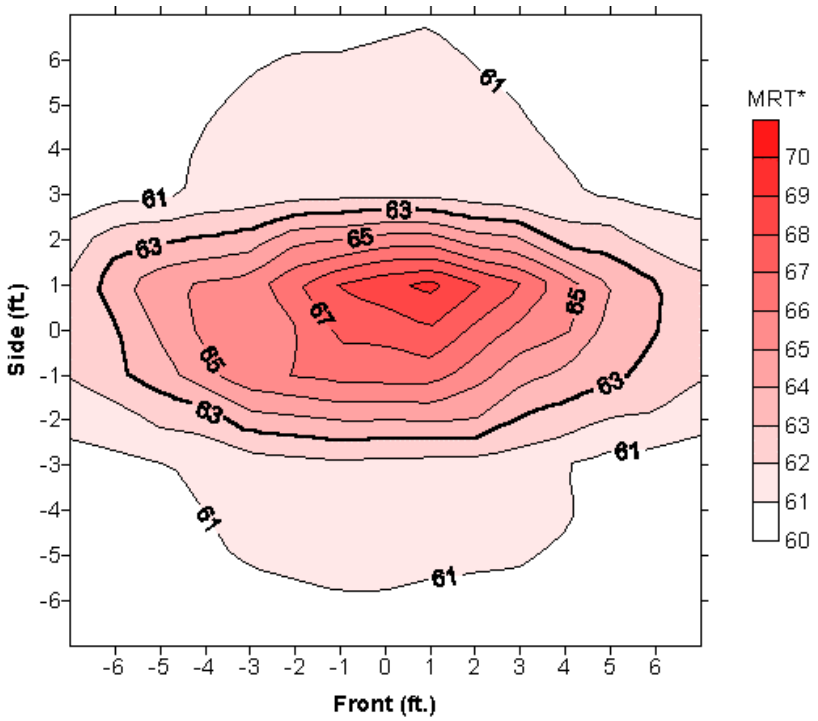
*MRT- Mean Radiant Temperature, normalized to a 60°F ambient.

Figure 6. Heated area test #1.



*MRT- Mean Radiant Temperature, normalized to a 60°F ambient.

Figure 7. Heated area test #2.



*MRT- Mean Radiant Temperature, normalized to a 60°F ambient.

Figure 8. Heated area test #3.

Patio Heater Heating Index:

The heating index is the number of square feet of patio effectively heated for each unit of energy (kilowatt) consumed by the heater.

Energy Input Rate	3.1 kW
Heated Area	51.1 sqf
Heating Index	16.5 ft^2/kW