Sunglo™ Heater Model A242
Patio Heater Performance Test

FSTC Report # 5011.06.16

Food Service Technology Center
November 2006

Prepared by:
Greg Sorensen
David Zabrowski
Fisher-Nickel, Inc.

The information in this report is based on data generated at the Food Service Technology Center.

Acknowledgments

California consumers are not obligated to purchase any full service or other service not funded by this program. This program is funded by California utility ratepayers under the auspices of the California Public Utilities Commission.

Los consumidores en California no estan obligados a comprar servicios completos o adicionales que no esten cubiertos bajo este programa. Este programa esta financiado por los usuarios de servicios públicos en California bajo la jurisdiccion de la Comision de Servicios Públicos de California.

A National Advisory Group provides guidance to the Food Service Technology Center Project. Members include:

A National Advisory Group provides guidance to the Food Service Technology Center Project. Members include:

Applebee's International Group

California Energy Commission (CEC)

Denny's Corporation

East Bay Municipal Utility District

Enbridge Gas Distribution Inc.

EPA Energy Star

Gas Technology Institute (GTI)

In-N-Out Burger

National Restaurant Association

Safeway, Inc.

Southern California Edison

Underwriters Laboratories (UL)

University of California at Berkeley

University of California at Riverside

US Department of Energy, FEMP

Specific appreciation is extended to Infrared Dynamics, for supplying the Food Service Technology Center with the Sunglo™ Heater for controlled testing in the appliance laboratory.

Policy on the Use of Food Service Technology Center Test Results and Other Related Information

- Fisher-Nickel, inc. and the Food Service Technology Center (FSTC) do not endorse particular products or services from any specific manufacturer or service provider.
- The FSTC is *strongly* committed to testing food service equipment using the best available scientific techniques and instrumentation.
- The FSTC is neutral as to fuel and energy source. It does not, in any way, encourage or promote the use of any fuel or energy source nor does it endorse any of the equipment tested at the FSTC.
- FSTC test results are made available to the general public through technical research reports and publications and are protected under U.S. and international copyright laws.
- In the event that FSTC data are to be reported, quoted, or referred to in any way in publications, papers, brochures, advertising, or any other publicly available documents, the rules of copyright must be strictly followed, including written permission from Fisher-Nickel, inc. *in advance* and proper attribution to Fisher-Nickel, inc. and the Food Service Technology Center. In any such publication, sufficient text must be excerpted or quoted so as to give full and fair representation of findings as reported in the original documentation from FSTC.

Legal Notice

This report was prepared as a result of work sponsored by the California Public Utilities Commission (Commission). It does not necessarily represent the views of the Commission, its employees, or the State of California. The Commission, the State of California, its employees, contractors, and subcontractors make no warranty, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the use of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the Commission nor has the Commission passed upon the accuracy or adequacy of the information in this report.

Disclaimer

Neither Fisher-Nickel, inc. nor the Food Service Technology Center nor any of its employees makes any warranty, expressed or implied, or assumes any legal liability of responsibility for the accuracy, completeness, or usefulness of any data, information, method, product or process disclosed in this document, or represents that its use will not infringe any privately-owned rights, including but not limited to, patents, trademarks, or copyrights.
Reference to specific products or manufacturers is not an endorsement of that product or manufacturer by Fisher-Nickel, inc., the Food Service Technology Center or Pacific Gas & Electric Company (PG&E).
Retention of this consulting firm by PG&E to develop this report does not constitute endorsement by PG&E for any work performed other than that specified in the scope of this project.

Contents

List of Figures and Tables

Figures

Tables

Patio Heater Performance Testing

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.

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]

The primary objective of this procedure is to determine the area under or near the heater where a person could reasonably expect to be comfortable. Relating a person's thermal comfort at specific locations under the heater can be challenging, since the environment is not uniform. Some surfaces are hot, while others may be cold when compared to the surface temperature of a person's body or clothing. Mean radiant temperature is a measure of the combined affect of these non-uniform, hot and cold surfaces on a body (person) within the space.

The test procedure uses mean radiant temperature to characterize the useful output from a radiant patio heater. The useful output is specified as the area under and around the heater having a mean radiant temperature rise of at least 3°F in a design environment of 60°F. While a 3°F temperature rise does not sound like much, it is referring to a rise in radiant temperature, which is more noticeable than a 3°F rise in ambient temperature. Stated another way, a heater producing a 3°F rise in mean radiant temperature in a 60°F environment would feel warmer than an environment with an ambient temperature of 63°F.

Infrared Dynamics has developed the Sunglo™ line of heaters that incorporate a gas-fired burner located beneath a dome-shaped reflector. The heaters are available in permanent-pole mount, freestanding pole-mount, and suspended configurations. In addition to the natural gas fired models, a propane-fired version is available in a portable freestanding configuration.

Objective

The objective of this report is to examine the operation and performance of the Infrared Dynamics Sunglo™ natural gas-fired patio heater 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 is 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 Sunglo™ A242 heater is a natural gas fired, dome-type patio heater (Figure 1). Heat is generated by a 50,000 burner mounted on a freestanding pole, with an aluminum reflector directly above the burner. The heater measures 93" high with a reflector diameter of 34 ½".

*Figure 1.
Infrared Dynamics
Sunglo™ Heater.*

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

Table 1. Appliance Specifications.

Manufacturer	Infrared Dynamics
Model	Sunglo™ A242
Generic Appliance Type	Dome-type Heater
Rated Energy Input Rate	50,000 Btu/h
Construction	Stainless or Painted Steel Base and Pole, Aluminum Reflector
Ignition	Direct Spark
Dimensions	93" High, 34½" Reflector Diameter

Setup and Instrumentation

The Sunglo™ heater was installed in accordance with the manufacturer's instructions and Section 9 of the FSTC test method.[1] Gas consumption was monitored using a positive displacement meter, which generated a pulse for every 0.1 ft^3 of gas used. Heater temperature was monitored with a 24 gauge, type K, fiberglass insulated thermocouple wire.

The mean radiant temperature can be determined at a specific point under the heater with a globe thermometer. A globe thermometer, shown in Figure 2, consists of a thermocouple placed in the geometric center of a sphere. The thermocouple measures the surface temperature of the sphere, and, when combined with the ambient air temperature and the convection heat transfer for the sphere, can be used to calculate the mean radiant temperature for that location. By using an array of globe thermometers, the entire area under the heater can be covered.

After calculating the mean radiant temperature of the space both with and without the heater operating, the effect of the heater can be determined. Once the effect of the heater at a specific ambient temperature is known, its effect on a design environment having a different ambient temperature can be calculated. With a minimum temperature rise specified, a boundary is drawn and the heated area calculated.

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. Figure 3 shows the globe thermometer grid. The transducer and all thermocouples were connected to a computerized data acquisition unit that recorded data every 10 seconds.

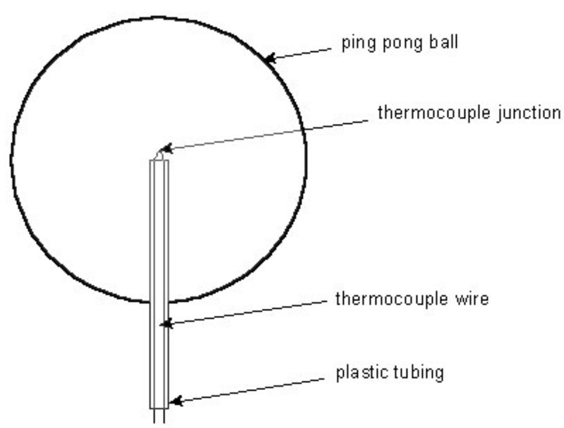


Figure 2.
Globe thermometer design.

Figure 3.
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 maximum energy input rate was 49,580 Btu/h, which is within 0.8% of the heater's nameplate rating (50,000 Btu/h). 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 by the thermocouple attached to the reflector). The test continued until the reflector temperature had stabilized to within ±3°F over a period of 5 minutes. The point when the reflector temperature had reached 95% of its maximum temperature was then determined. 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 reflector temperature of 603.2°F, which meant the heater was considered preheated when the reflector reached 573.0°F (95% of maximum). The heater reached this temperature in 9.7 minutes, while consuming 7,930 Btu of energy. The preheat chart for the Sunglo™ heater is shown in Figure 4.

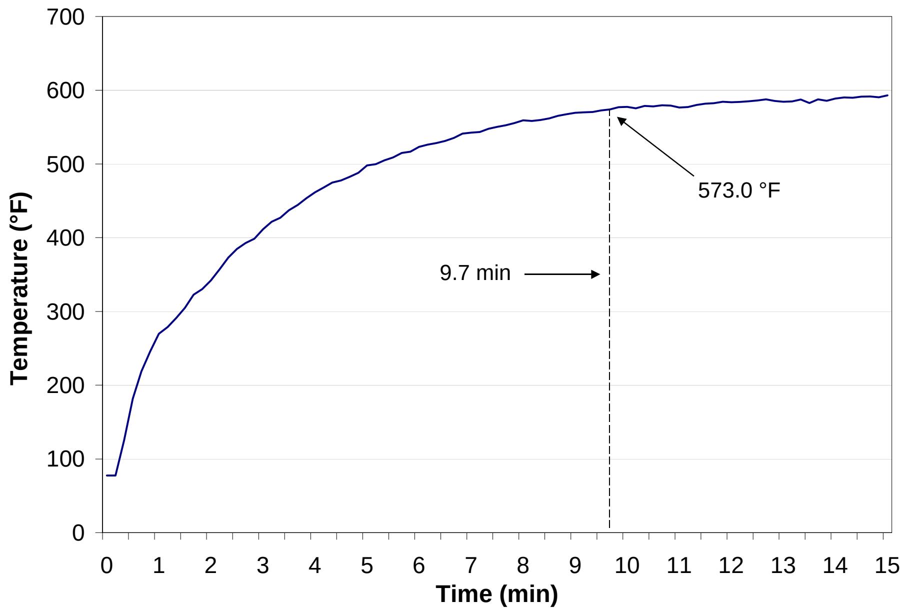


Figure 4.
Preheat characteristics.

Table 2 summarizes the results of the input and preheat tests for the Sunglo™ heater.

Table 2. Input and Preheat Test Results.

Rated Energy Input Rate (Btu/h)	50,000
Measured Energy Input Rate (Btu/h)	49,580
Percentage Difference From Rated (%)	0.8
Preheat	
Time (min)	9.7
Energy (Btu)	7,930

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.

The heater was placed in the center of the test cell with the base in direct contact with the floor.

To confirm that all test apparatus was in a stable condition, the temperatures of the globe thermometers and the burner shield 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. This test was performed in triplicate to ensure the accuracy of the results.

In order to generate the heated area plots, each average globe thermometer temperature from the 5-minute test was first normalized to the design mean radiant temperature. 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 where one globe is above the threshold temperature and an adjacent globe is below it.

The distribution plot for the heater shown in Figure 5 includes the 63°F temperature boundary specified by the test method, as well as additional boundaries indicating further temperature rises in increments of 1°F.

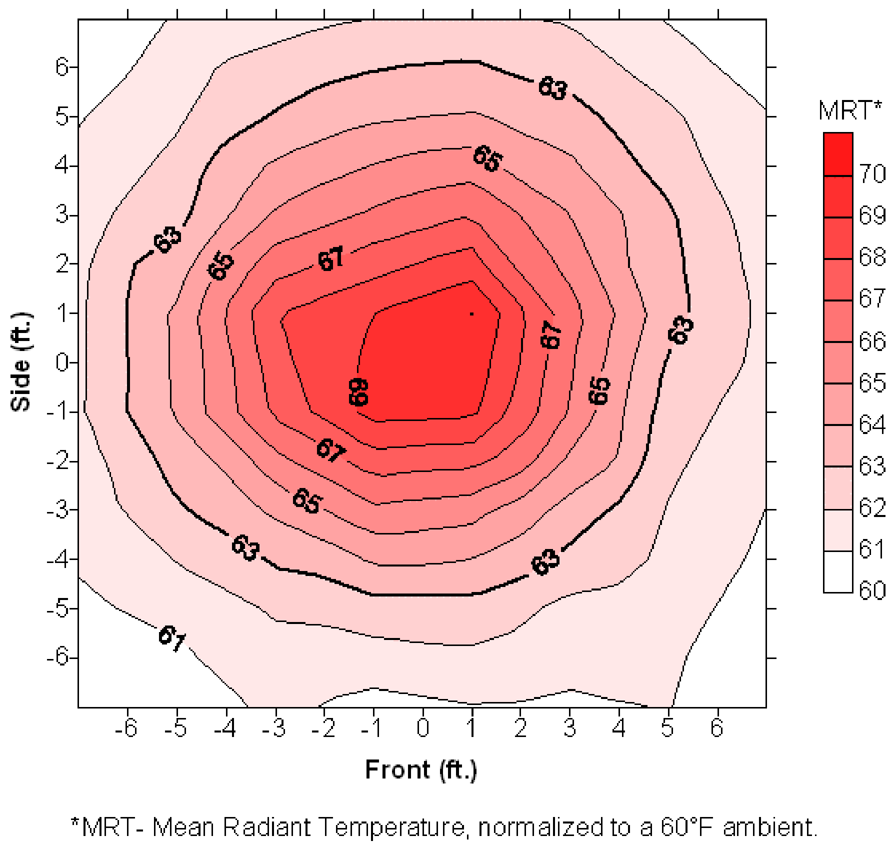


Figure 5. Temperature distribution plot.

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 Sunglo™ heater was 96.6 ± 3.9 ft^2.

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

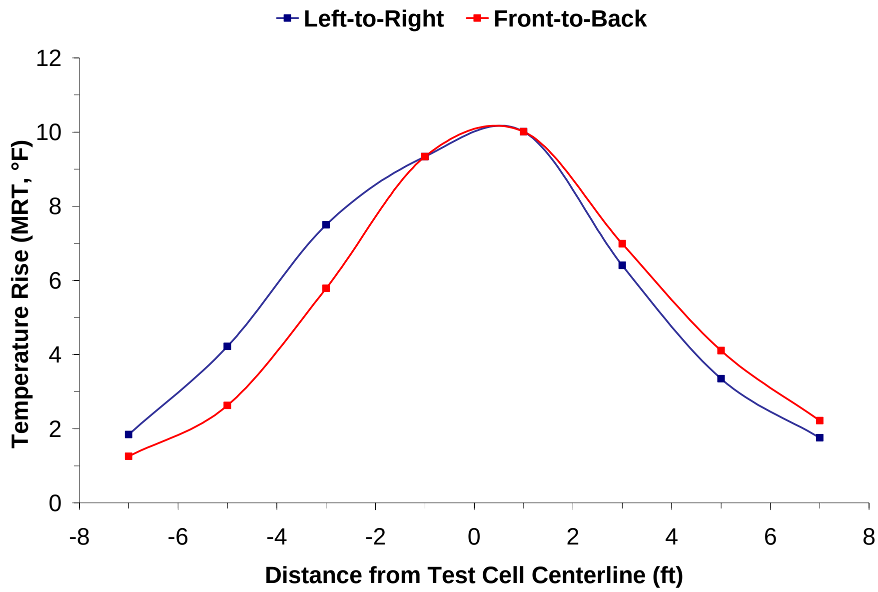


Figure 6. Radiant Heat Distribution.

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 1.95 ft^2/kBtu/h for the Sunglo™ heater.

Conclusions

The Sunglo™ heater produced a round-shaped temperature distribution with an effective heated area of 96.6 ± 3.9 ft^2. The effective heated area represents the part of the test cell raised to at least 3°F above the ambient design environment, and as the mean radiant globe temperature and temperature distribution plots show, the Sunglo™ heater generated a 69°F maximum mean radiant temperature in the center of the heat pattern.

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 his or her particular needs. In that regard, the Sunglo™ heater is well suited to applications requiring a dome-type, gas-fired 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. 2003. *Infratech Model W-3024 Patio Heater Performance Test.* Food Service Technology Center Report 5011.03.11, August.

3. Sorensen, G., Zabrowski, D., 2004. *Roberts-Gordon Model HE-40 Patio Heater Performance Test.* Food Service Technology Center Report 5011.04.11, December.

4. Sorensen, G., Zabrowski, D., 2005. *Schwank, Model 2315 Patio Heater Performance Test.* Food Service Technology Center Report 5011.05.05, March.

5. Sorensen, G., Zabrowski, D., 2005. *Schwank, Model 2313 Patio Heater Performance Test.* Food Service Technology Center Report 5011.05.06, March.

6. Sorensen, G. 2005. *Easy Radiant Model PH-50-H-R-N Patio Heater Performance Test.* Food Service Technology Center Report 5011.05.04, December.

7. Sorensen, G., Zabrowski, D., 2006. *Sunpak® Heater Model S34 Patio Heater Performance Test*. Food Service Technology Center Report 5011.06.11, August.

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 mean radiant temperature (3°F above the design environment).

Efficiency Index (Btu/ft^2)

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

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/kBtu/h)

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 preheat.

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 Infrared Dynamics Sunglo™ heater.

sunglo® The Original Outdoor Patio Heater

MODEL A242

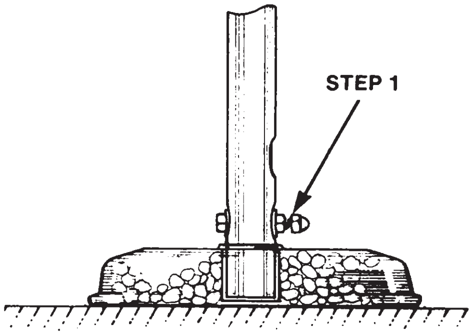
GAS-FIRED INFRARED HEATER
For Indoor or Outdoor Operation

Installation Instructions

Step 1.

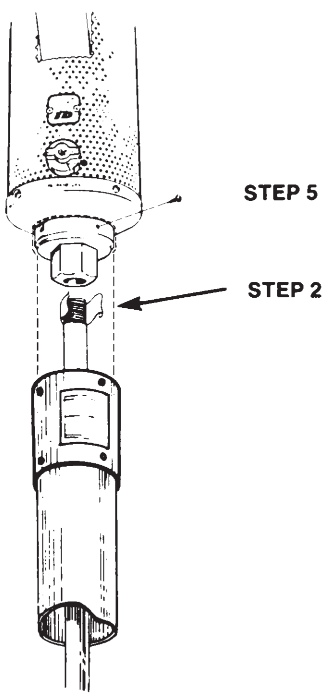
a. Insert 3" dia. post squarely into base socket.

b. Tighten nut on bolt to secure post until ½" of thread is exposed. Slight indent of post should occur. Install cap nut.



Step 2.

a. Thread 62" long internal pipe nipple into base of heater head as shown below. If teflon tape is not provided, gas pipe joint compound must be used at this joint.



Step 3.

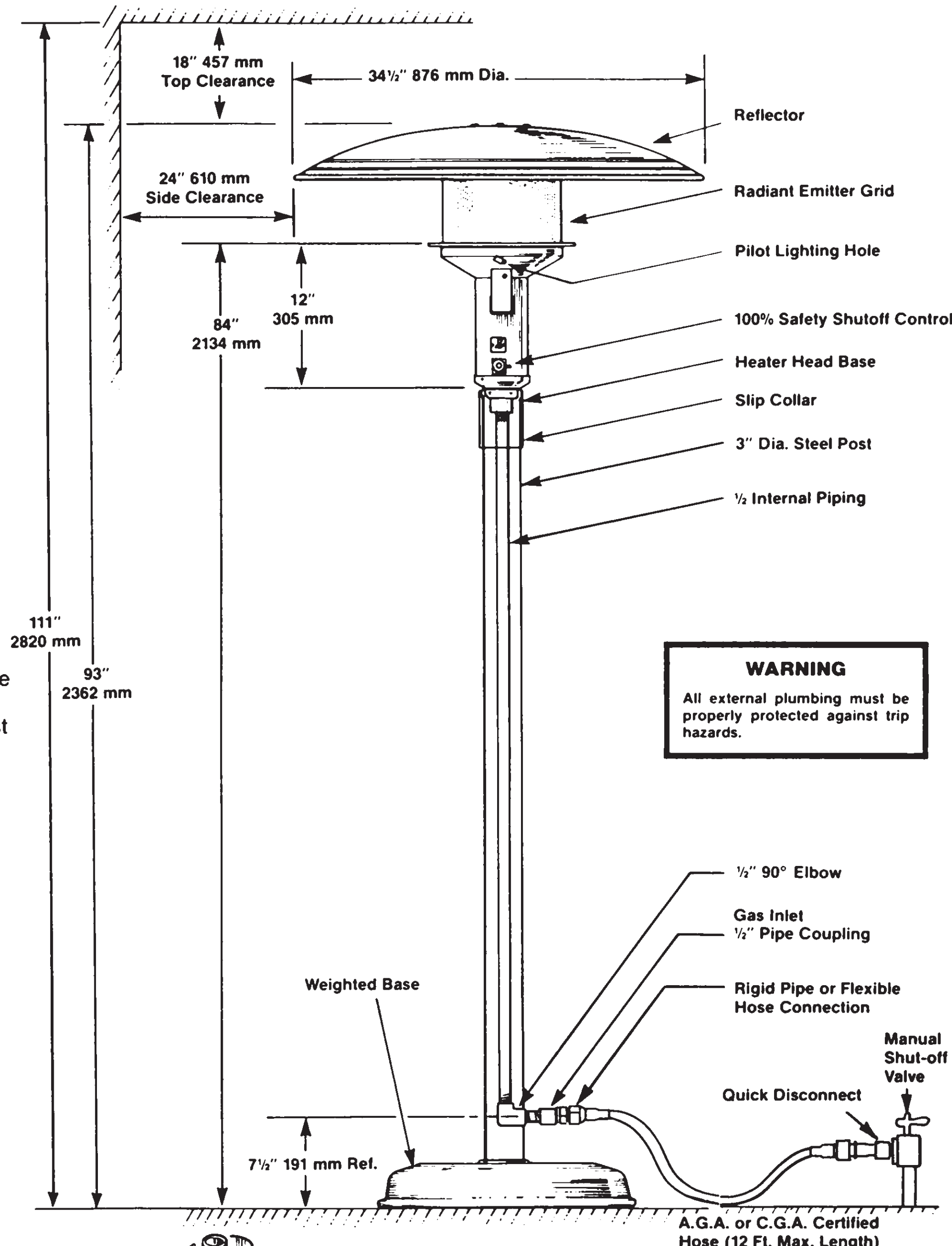
a. Slide assembled gas pipe and heater head into post.

b. Turn heater head so pipe elbow fitting lines up with hole at the bottom of the post.

Step 4.

a. Screw ½ nipple into elbow using gas pipe joint compound as shown below.

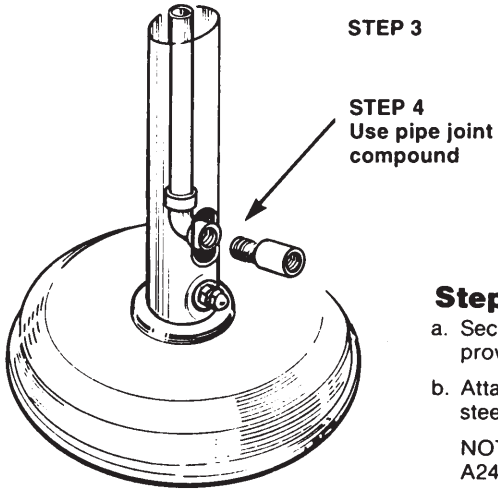
Minimum Clearance from Combustible Materials



WARNING

All external plumbing must be properly protected against trip hazards.

STEP 3



Step 5.

a. Secure heater slip collar with four (4) screws provided.

b. Attach reflector to top of heater with stainless steel nuts provided.

NOTE: To bolt base to deck, Order #27020, A242 Floor Clamp Kit.

C Results Reporting Sheets

Manufacturer: Infrared Dynamics

Model: Sunglo™

Date: August, 2006

Test Patio Heater:

Description of operational characteristics: Gas-fired, infrared burner patio heater.

Apparatus:

The heater was installed in a 20 by 20-foot space. 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 14 by 14-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.

Energy was monitored using a positive displacement meter that generated a pulse for every $0.1ft^3$ of gas used. The gas meter and thermocouples were connected to an automated data acquisition unit that recorded data every 5 seconds.

Energy Input Rate:

Measured	49,580 Btu/h
Rated	50,000 Btu/h
Percent Difference between Measured and Rated	0.8 %
Electrical Energy Input Rate	N/A

Preheat:

Preheat Time	9.7 min.
Preheat Energy	7,930 Btu

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.

Effective Heated Area: 96.6 ± 3.9 ft^2

Patio Heater Heating Index:

The heating index is the number of square feet of patio effectively heated for each unit of energy (kBtu) consumed by the heater. The results for the Sunglo™ heater are shown in Table C-1.

Table C-1. Heating Index.

Energy Input Rate	49,580 Btu/h
Heated Area	96.6 ft^2
Heating Index	1.95 ft^2/kBtu/h
Efficiency Index	513 Btu/ft^2

D Test Cell Data

Mean Radiant Temperature Distribution:

Table D-1 shows the average normalized mean radiant temperatures from the three test replicates.

Test Cell Data

Table D-1. Normalized Mean Radiant Temperatures.

Globe Position[†]		Test Replicate		
X	Y	Test 1	Test 2	Test 3
5	7	61.1	60.7	61.0
3	7	62.0	61.7	62.0
1	7	62.2	62.3	62.2
-1	7	62.0	62.1	62.0
-3	7	61.6	61.8	61.6
-5	7	61.0	61.4	60.9
5	5	62.2	62.1	62.3
3	5	63.4	63.2	63.5
1	5	64.2	63.7	64.4
-1	5	64.0	63.7	64.0
-3	5	63.1	63.3	63.0
-5	5	61.7	62.3	61.6
5	3	63.1	63.0	63.3
3	3	65.1	64.9	65.2
1	3	67.0	66.8	67.2
-1	3	66.3	65.9	66.4
-3	3	65.2	65.1	65.2
-5	3	62.6	63.0	62.4
5	1	63.3	63.3	63.5
3	1	66.3	66.2	66.6
1	1	70.0	69.8	70.2
-1	1	69.0	69.0	69.0
-3	1	68.0	67.9	68.0
-5	1	64.2	64.5	64.0
5	-1	62.3	62.6	62.4
3	-1	65.7	65.9	66.1
1	-1	69.2	69.1	69.4
-1	-1	69.4	69.0	69.6
-3	-1	67.1	67.1	67.5
-5	-1	64.2	64.2	64.0
5	-3	61.9	62.2	61.7
3	-3	63.5	63.8	63.6

Globe Position[†]		Test Replicate		
X	Y	Test 1	Test 2	Test 3
1	-3	65.4	65.3	62.7
-1	-3	65.8	65.6	61.2
-3	-3	64.2	63.9	61.5
-5	-3	62.9	62.9	62.5
5	-5	61.3	61.5	62.6
3	-5	61.7	62.0	62.1
1	-5	62.5	62.9	61.4
-1	-5	62.5	62.5	61.1
-3	-5	62.0	62.2	60.8
-5	-5	61.3	61.2	60.8
5	-7	61.1	60.9	60.6
3	-7	60.7	61.1	61.3
1	-7	60.8	61.2	60.4
-1	-7	60.5	60.8	60.7
-3	-7	61.2	61.3	61.3
-5	-7	60.2	60.3	61.9
-7	5	60.7	61.3	61.7
-7	3	61.5	62.3	61.1
-7	1	61.4	62.2	60.6
-7	-1	61.5	62.4	61.2
-7	-3	61.3	61.7	61.5
-7	-5	60.9	61.0	61.8
7	5	61.0	61.0	61.4
7	3	61.3	61.3	60.9
7	1	61.6	61.9	60.7
7	-1	61.4	61.7	60.0
7	-3	61.0	61.1	60.0
7	-5	60.6	60.5	60.0
-7	-7	60.0	60.0	60.0
-7	7	60.0	60.0	62.7
7	7	60.0	60.0	61.2
7	-7	60.0	60.0	61.5

[†] Distance from test cell centerline, in feet