



**Keating MIRACLEAN Model 36 x 30  
IBLD Gas Griddle: Application of ASTM  
Standard Test Method F 1275-90**

Report 5017.93.3

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## PREFACE

Historically, performance testing of commercial cooking appliances has been conducted by food service equipment manufacturers and research organizations under controlled laboratory conditions. However, key decision makers in the food service industry have long seen a need to evaluate appliance performance under real-life conditions. Pacific Gas and Electric Company (PG&E) is providing this opportunity at its Food Service Technology Center (FSTC) in San Ramon, California.

The FSTC has three components. The first, the Production-Test Kitchen, is a unique combination of a real food service operation and a testing laboratory at PG&E's corporate Learning Center dining facility. As a testing lab, it is equipped to measure the energy consumed by gas and electric cooking appliances as they are used for menu production. As a production kitchen, operated by the staff of a contract food service management company, the 162-seat dining facility provides cafeteria-style breakfast and lunch and table service dinner for the students and staff at PG&E's Learning Center.

The second is a 6,700-square-foot appliance research laboratory, which complements the Production-Test Kitchen by supporting the development and application of standard methods of tests for commercial food service equipment. The laboratory also provides an arena for identification and investigation of environmental issues related to food service facilities.

Technology transfer is the third component, *Restaurants & Institutions* magazine publishes the results of FSTC research in a national subscription service called the *Kitchen Monitor*. Other technical reports produced by the FSTC are also available through the *Kitchen Monitor*. For more information write or call Corinne Zollars, *Kitchen Monitor*, 1350 East Touhy Avenue, Des Plaines, IL 60018 (708-390-2086; fax 708-635-6856).

## ACKNOWLEDGMENTS

The establishment of a state-of-the art Food Service Technology Center reflects PG&E's commitment to the hospitality industry. The goal of the research project is to provide PG&E's food service customers with information to help them evaluate technically innovative cooking appliances and make informed equipment purchases regarding advanced technologies and energy sources. The project was the result of many people and departments working together within PG&E and the overwhelming support of the commercial equipment manufacturers who loan the cooking appliances for testing. Specific appreciation is extended to Keating® of Chicago, Inc., for supplying PG&E with a Model 36 x 30 IBLD MIRACLEAN gas griddle for testing at the Food Service Technology Center.

PG&E's Food Service Technology Center acknowledges the support of the project's National Advisory Group. Participating organizations from the research community include the Electric Power Research Institute (EPRI), the Gas Research Institute (GRI), the American Gas Association Laboratories (AGAL), and Underwriters Laboratories (UL). Representing end users are the National Restaurant Association, Restaurants & Institutions, McDonald's Corporation, General Mills Restaurants, and Marriott International. Academia is represented by The Pennsylvania State University.

## EXECUTIVE SUMMARY

This study documents the performance of the Keating MIRACLEAN gas griddle, model 36 x 30 IBLD, as determined by applying a revised version of the American Society for Testing and Materials' (ASTM) *Standard Test Methods for the Performance of Griddles* (Designation F 1275). Such revisions include monitoring preheat and recovery during cooking tests by cooking surface temperature and determining independent cooking times for each loading scenario.

Griddle performance is characterized by temperature uniformity, preheat time and energy consumption, idle energy consumption, pilot energy consumption, water-boil and cooking energy efficiencies, and production capacity. A summary of the test results is presented in Table ES-1.

**Table ES-1**  
**Summary of Griddle Performance**

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Rated Energy Input Rate:	80 kBtu/h
Measured Energy Input Rate	84.0 kBtu/h
Temperature Uniformity:	± 45°F
Preheat Time:	9.0 min
Preheat Energy:	13.5 kBtu
Idle Energy Rate @ 375°F:	14.4 kBtu/h
Pilot Energy Rate:	3.2 kBtu/h
Water-Boil Efficiency:	53.0%
Full-Load Cooking Efficiency:	44.2%
Half-Load Cooking Efficiency:	36.6%
Light-Load Cooking Efficiency:	16.1%
Production Capacity: <sup>a</sup>	48.0 lb/h

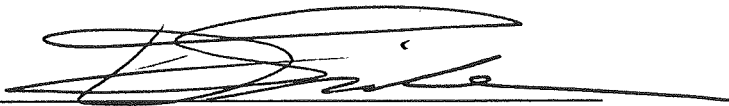
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<sup>a</sup>Based on the full-load cooking test.

The performance of the Keating griddle was considered favorable for an infrared griddle—particularly with respect to energy efficiency under full- and half-load conditions. The infrared technology provides a more efficient combustion, allowing for a higher cooking energy efficiency than traditional atmospheric burners. Other benefits of the infrared burners include a quick recovery during cooking and a fast preheat.

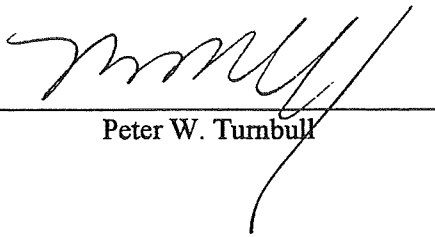
The 44.2% full-load efficiency and 48-lb/h productivity make this griddle well suited for high-output applications. An electronic ignition in lieu of standing pilots would conserve energy, adding even greater appeal to this appliance.

FSTC Manager



Donald R. Fisher

Technical Support Supervisor



Peter W. Turnbull

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Section 1  
**INTRODUCTION**

**BACKGROUND**

Numerous PG&E reports have documented the development of test procedures for cooking equipment<sup>1</sup> and the results of appliances tested in the Production-Test Kitchen, including the appliances' natural gas and electric energy use under varying conditions. Much of this information was not previously available, or if available, had been determined by a variety of test procedures. PG&E's Food Service Technology Center (FSTC) has been developing uniform testing procedures (UTPs) to provide standard methods of testing commercial cooking appliances, and is submitting these procedures to the American Society for Testing and Materials (ASTM) for approval as national standard test methods.

Since publication of the ASTM *Standard Test Methods for the Performance of Griddles* (Designation F 1275),<sup>2</sup> the FSTC has been exploring possible areas for improvement in the test method. Through sensitivity testing and comparison of the results from procedure to procedure, FSTC researchers developed a set of revisions that improve upon various sections in the ASTM test method. These revisions will be incorporated into the next version of the ASTM test method. PG&E has previously tested five griddles (three gas and two electric) according to the ASTM test method.<sup>1,3</sup> The revised procedures were applied to the Keating gas infrared griddle, and this report documents the results.

The glossary in Appendix A is provided so that the reader has a quick reference for the terms used in this report.

**OBJECTIVES**

The objective of this study is to examine the operation and performance of the Keating MIRACLEAN gas infrared griddle, model 36 x 30 IBLD, under the controlled conditions of the revised ASTM test method.<sup>2</sup> The scope of this testing is as follows:

- Document the temperature uniformity of the cooking surface and the accuracy of the thermostats.
- Verify that the appliance is operating at the manufacturer's rated energy input.
- Document the pilot energy consumption.
- Characterize the preheat and idle energy use under controlled conditions.
- Determine the efficiency when boiling water.

- Document the cooking energy consumption and efficiency under three loading scenarios (full, half, and light).
- Determine the production capacity and cooking surface temperature recovery time.

## APPLIANCE DESCRIPTION AND OPERATION

The thermostatically controlled griddle is powered by four gas infrared burners. The infrared burner mixes gas with air as the gas enters the venturi, and the mixture is forced through a fine stainless-steel screen. This mixture ignites on the outside surface of the screen, causing it to glow red. The glowing screen emits infrared radiation; the bottom of the griddle plate collects the radiation, thereby heating the plate. Appliance specifications are listed in Table 1-1 and the manufacturer's literature is in Appendix B.

**Table 1-1  
Appliance Specifications**

Manufacturer:	Keating® of Chicago, Inc.
Model:	36 x 30 IBLD
Generic Appliance Type:	Thermostatically controlled griddle
Rated Energy Input:	80 kBtu/h
Dimensions:	30" x 36"
Construction:	3/4"-thick polished 40/50 carbon steel, coated with trivalent chromium
Controls:	Two individual zones, each with a thermostat, on-off switch, and indicator light
Accessories:	Razor blade scraper, extra blades, palmetto brush, and a Keating Klenzer sample

## Section 2 METHODS

### REVISIONS TO ASTM STANDARD TEST METHOD

During the course of expanding the ASTM *Standard Test Methods for the Performance of Griddles* to include newer technologies, researchers at PG&E's Food Service Technology Center developed a revised test method. The revised method has broader applicability and higher repeatability. The following sections of the ASTM test method were affected: energy input rate (section 9.2), preheat energy consumption (section 9.4), cooking time determination (section 9.7), cooking energy efficiency and cooking capacity for a full-load test (section 9.8) and for half- and light-load tests (section 9.9).

In making the ASTM test method more applicable to real-world production, researchers chose to characterize the energy input rate and the preheat energy consumption by surface temperature rather than burner cycling. Researchers observed surface temperature by tack-welding thermocouples to the cooking surface on the point directly above each thermostat sensor and measuring the amount of time it took to preheat the cooking surface from room temperature to 375°F.

Rather than conducting the cooking time determination as a separate test with eight hamburger patties, researchers started each cooking energy efficiency and cooking capacity test with the cooking time determination for that loading scenario, using the number of patties dictated by the loading scenario. After establishing the proper cook time, the cooking test began with a stabilization load. A six-load run followed, during which time researchers monitored griddle energy consumption and determined bulk temperature and weight loss for each load.

To improve the accuracy of the bulk temperature measurements during the cooking tests (sections 9.7, 9.8, and 9.9), FSTC researchers specified a calorimeter which held eight hamburger patties and had five fixed temperature probes in the lid. Bulk temperature of the cooked patties is defined as the average of these five thermocouples after 2 minutes in the calorimeter. Calorimeter patties were chosen at random from the cooking surface. Visual inspection of the cooked patties was eliminated, and patty doneness was based on bulk temperature and weight loss only.

For sections 9.8 and 9.9, a threshold temperature of 365°F at the center of each linear foot of cooking surface was used as a recovery criterion in place of burner cycling. This better characterizes griddle recovery. Surface temperature was monitored by tack-welding thermocouples to the cooking surface.

Instead of analyzing the moisture content of the cooked patties in the full-load test only, the researchers revised the procedure to include analysis in *all* loading scenarios to obtain more accurate cooking energy efficiency results (sections 9.8 and 9.9).

#### **TEST SETUP/INSTRUMENTATION**

The griddle was installed under a 4-foot-deep canopy hood, 6 feet 6 inches from the floor, as specified in section 8 of the ASTM test method.<sup>2</sup> The hood operated at a nominal exhaust rate of 300 cfm per linear foot.

Gas consumption was measured with a calibrated gas meter with a 0.01-cubic-foot resolution, and the temperature of the cooking surface was measured with K-type thermocouples. The gas meter was fitted with a contact-closure generating sensor, which allowed gas usage to be logged on a minute-by-minute basis. The thermocouples were welded to the griddle plate to obtain accurate temperature measurement.

Section 3  
**RESULTS**

**THERMOSTAT ACCURACY AND TEMPERATURE UNIFORMITY**

**Thermostat Accuracy**

FSTC researchers attached thermocouples to the cooking surface directly above the thermostat temperature sensing probes. After allowing the cooking surface to stabilize at 375°F for 1 hour, we monitored these points for 1 hour, and then manually calibrated the controls so that the temperature on the plate directly above the thermostat sensing probes was within 5°F of the set temperature.

**Temperature Uniformity**

We laid out additional monitoring points in a 35-point grid on the plate, 3 inches from each side, and stabilized the cooking surface for 1 hour. The plate temperatures were then monitored for 1 hour, and the temperatures at each point were averaged over the monitoring period.

**Test Results**

Table 3-1 lists the average temperatures above the thermostats and the maximum temperature difference across the cooking surface. The temperature sensing points and the resulting profile are illustrated in Figures 3-1 and 3-2.

**Table 3-1**  
**Thermostat Accuracy and Temperature Uniformity**

Left Thermostat (set @ 375°F):	377°F
Right Thermostat (set @ 375°F):	376°F
Maximum Temperature Difference Across Plate:	89°F

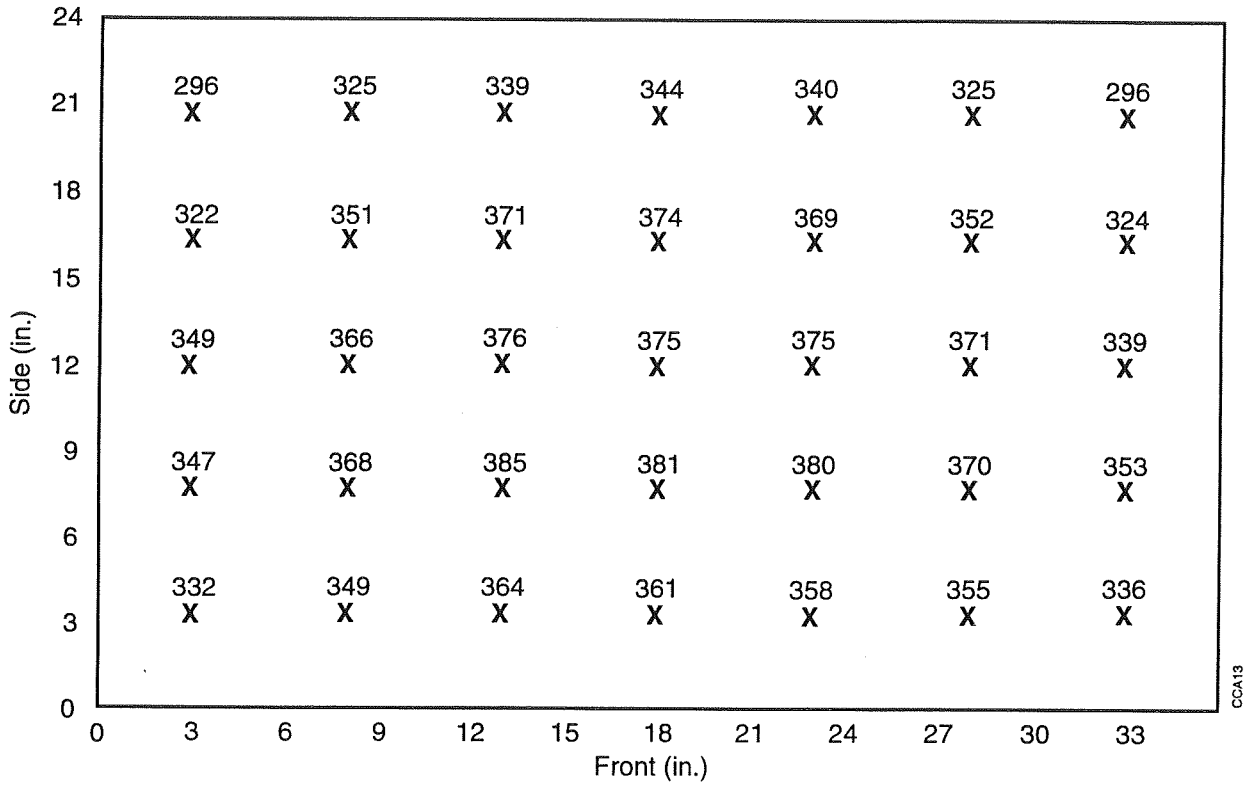


Figure 3-1. Temperature sensing points on the griddle surface.

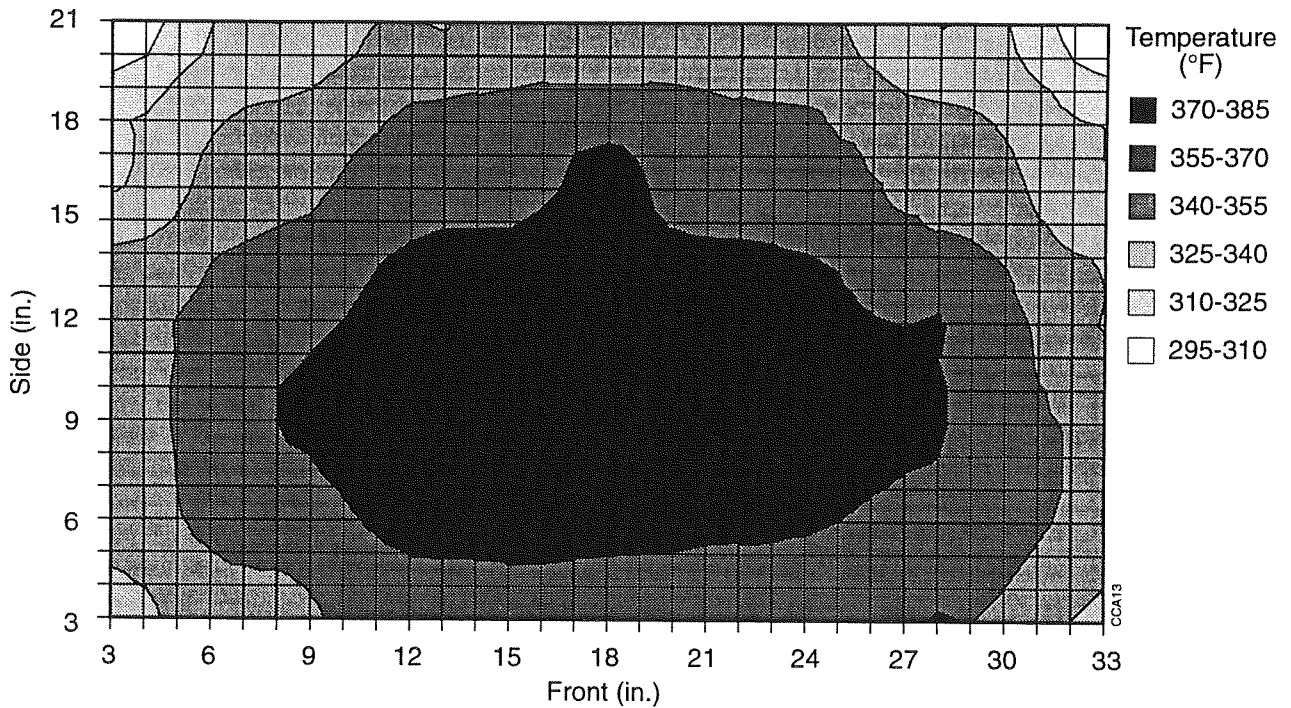


Figure 3-2. Temperature map of the griddle surface.

## **PREHEAT AND IDLE ENERGY CONSUMPTION**

### **Energy Input Rate**

The input gas pressure was 3.7 in. w.g. at the manifold when the griddle was operating at its rated input, whereas the nameplate input pressure is 4.0 in. w.g. Keating advised that the 4.0 in. w.g. rating is an upper limit, and the griddle is UL-verified for input pressures from 3.5 to 4.0 in. w.g. We therefore left the input pressure at 3.7 in. w.g. for testing, and determined the energy input rate by measuring the gas consumption during a preheat from an initial plate temperature of 83°F. The griddle is rated at 80.0 kBtu/h; based on a gas heating value of 1,019.1 Btu/ft<sup>3</sup>, we measured 84.0 kBtu/h.

### **Pilot Energy Consumption**

The pilots were monitored over a 13.6-hour period. The gas heating value during this monitoring period was 1,025.7 Btu/ft<sup>3</sup>. The total gas consumed during this time was 43.0 cubic feet, resulting in a pilot energy consumption rate of 3,200 Btu/h.

### **Preheat Energy Consumption**

This griddle required 9 minutes to preheat the cooking surface from 67°F to 375°F, consuming 13.5 kBtu. The gas heating value was 1,022.9 Btu/ft<sup>3</sup> for the preheat and idle test (they were conducted on the same day).

### **Idle Energy Consumption**

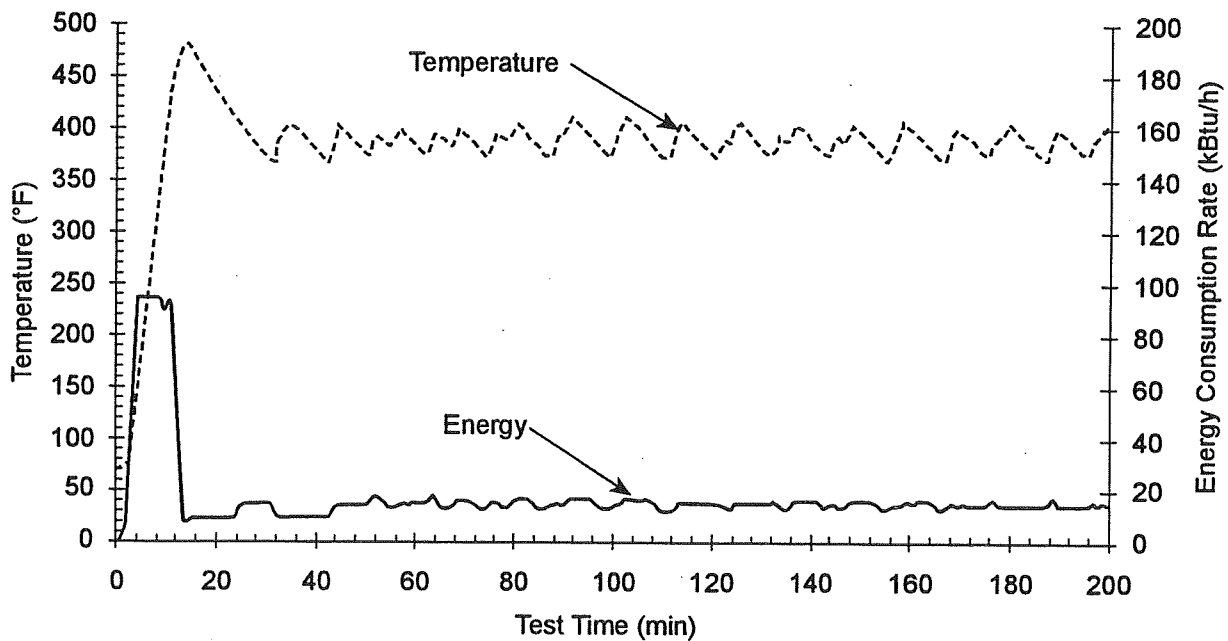
The griddle was allowed to stabilize at 375°F for 1 hour. After the plate stabilized, we monitored the energy over a 2-hour idle period. The idle energy rate was 14.4 kBtu/h.

### **Test Results**

The preheat and idle test results are summarized in Table 3-2. Figure 3-3 shows the energy consumption rate in conjunction with the plate temperatures above the thermostats during preheat and idle.

**Table 3-2**  
**Input, Preheat, and Idle Test Results**

Rated Energy Input Rate:	80.0 kBtu/h
Measured Energy Input Rate:	84.0 kBtu/h
Pilot Energy Consumption:	3,200 Btu/h
Preheat:	
Time to 375°F:	9.0 min
Energy:	13.5 kBtu
Rate to 375°F:	38°F/min
Idle Energy Rate @ 375°F:	14.4 kBtu/h



**Figure 3-3. Preheat and idle characteristics.**

## **WATER-BOIL AND COOKING PERFORMANCE TESTS**

### **Water-Boil Efficiency**

A water-boil test was conducted in accordance with section 9.6 of the ASTM test methods. The barometric pressure during the test was 14.609 psia, and the gas had a heating value of 1,026.7 Btu/ft<sup>3</sup>. After the griddle was stabilized by boiling 10 pounds of water, the griddle boiled off water at a rate of 47.2 lb/h. The calculated water-boil efficiency is 53.0%.

### **Cooking Performance**

All three tests were performed on the same day. The hamburger patties contained 22% fat (58% moisture), and the gas had a heating value of 1,022.8 Btu/ft<sup>3</sup>. The griddle was reloaded when the plate recovered to 365°F.

The full-load cooking test consisted of six loads and was completed in 44.7 minutes. Figures 3-4 and 3-5 illustrate plate temperature characteristics during the full-load test. On Keating's recommendation, the half- and light-loads tests were conducted with both sections of the griddle turned on.

### **Test Results**

Table 3-3 presents the results of the water-boil efficiency test and the cooking energy and production capacity tests. Figure 3-6 illustrates the relationship between the energy input rate and the production rate. Appendix C contains a summary of the application under full-, half-, and light-load scenarios. Average energy consumption rates at 10, 20, and 30 lb/h are 21, 27, and 34 kBtu/h, respectively. These values are used in the *Kitchen Monitor* for estimating the energy cost of this griddle in an actual food service establishment.

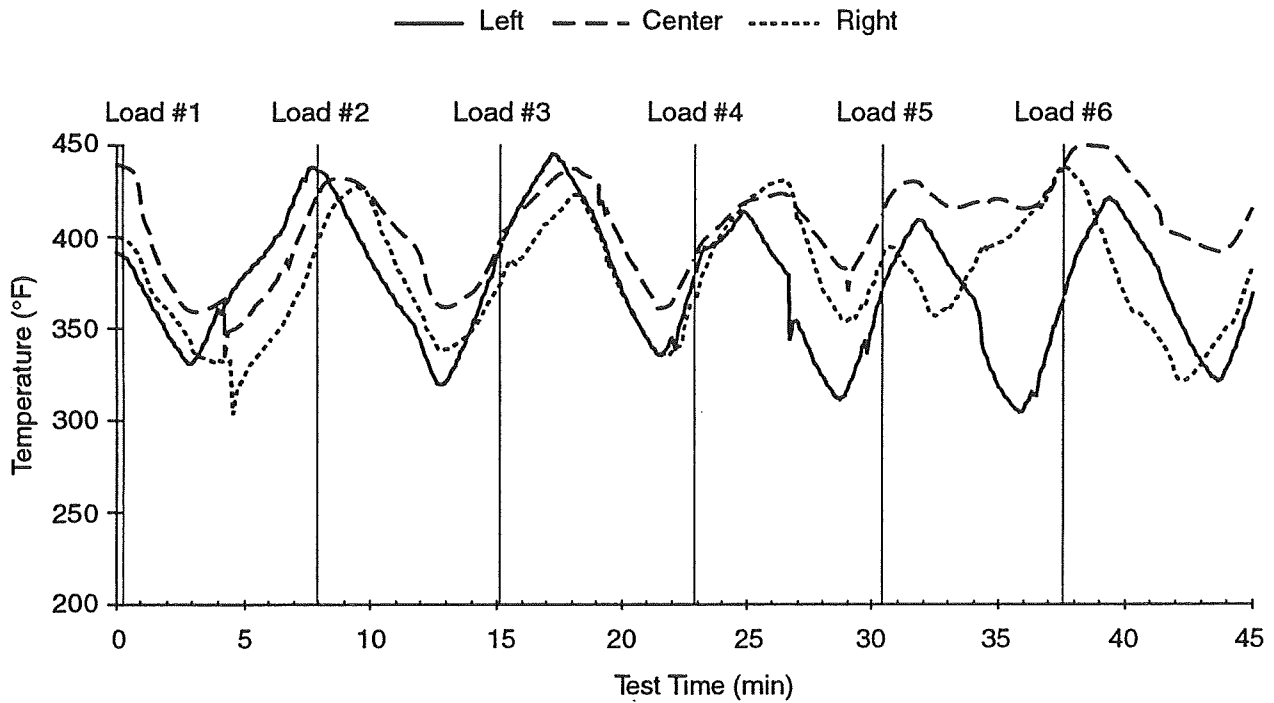


Figure 3-4. Cooking surface temperatures during a full-load test.

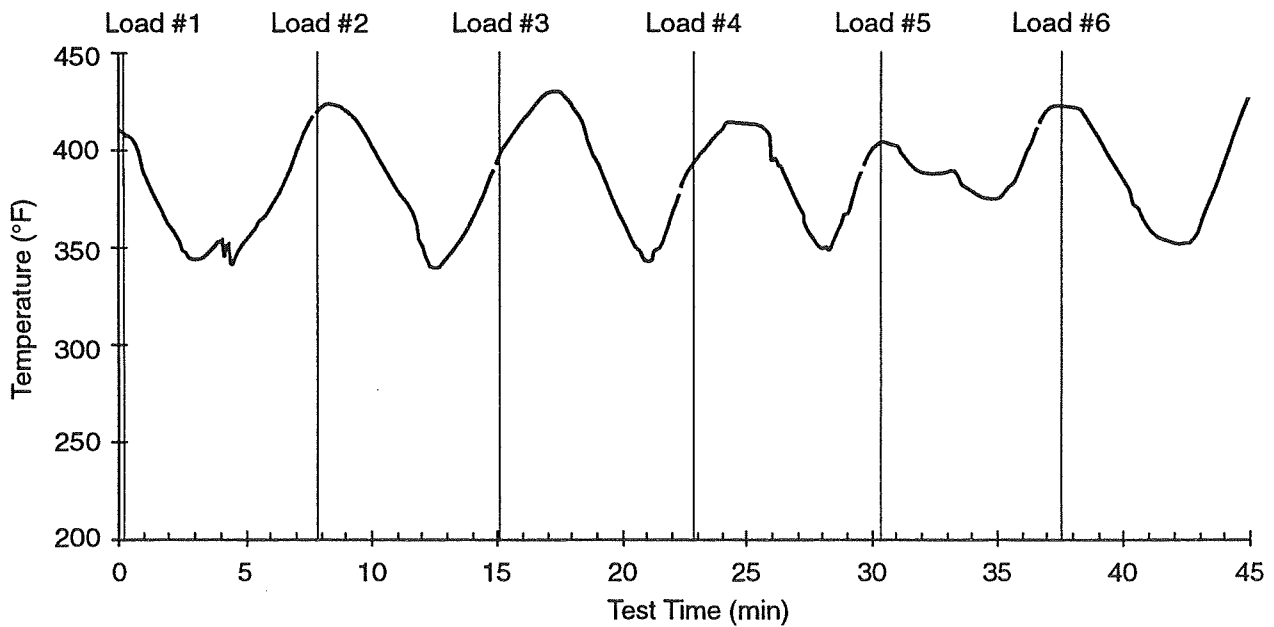


Figure 3-5. Average cooking surface temperature during a full-load test.

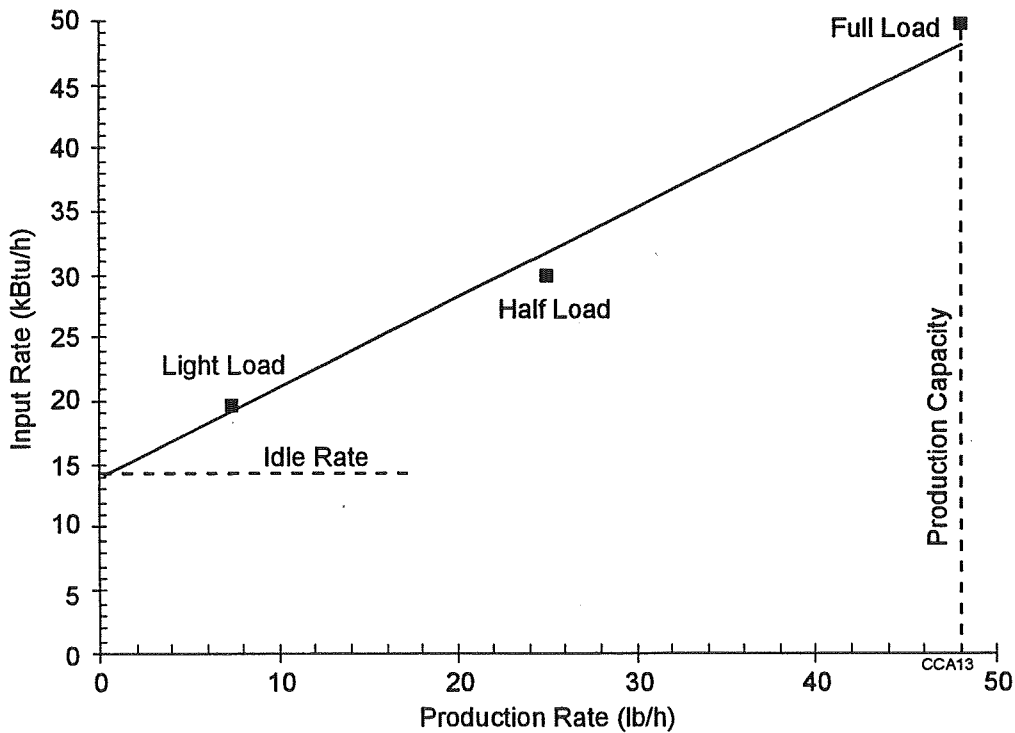
**Table 3-3**

**Water-Boil, Cooking Energy Efficiency, and Production Capacity Test Results**

Test Condition	Water Boil	Full Load	Half Load	Light Load
Patty Cook Time (min)	NA	6.0	5.75	5.75
Average Recovery Time (min)	NA	1.4	1.4	1.9
Production Rate (lb/h)	47.2 <sup>a</sup>	48.0	25.0	7.3
Energy Consumption (Btu/lb)	1,830 <sup>a</sup>	1,038	1,197	2,699
Average Input Rate (kBtu/h)	86.5	49.8	29.9	19.8
Energy Efficiency (%)	53.0	44.2	36.6	16.1

NA = Not applicable

<sup>a</sup>These quantities are based on pounds of water boiled off during the water-boil test.



**Figure 3-6. Energy input rate vs. production rate.**

## Section 4

### CONCLUSIONS AND RECOMMENDATIONS

The performance of the Keating griddle was considered favorable for an infrared griddle—particularly with respect to energy efficiency under full- and half-load conditions. For example, its cooking energy efficiency under the half-load hamburger patty test was significantly higher than the previously reported efficiency for an infrared griddle (36.6% vs. 31.0%).<sup>1</sup> In addition, its productivity (48 lb/h) is the highest reported for a comparably sized griddle.<sup>1,3</sup>

The griddle required 9 minutes to preheat to 375°F, compared to the 20-minute average preheat for other griddles. Additionally, it consumed 20% less energy during preheat than a previously tested infrared griddle.<sup>1</sup> However, the Keating's quick preheat is offset by an overshoot as high as 150°F.

The infrared technology provides a more efficient combustion, allowing for a higher cooking energy efficiency than traditional atmospheric burners (44% vs. 30% at full load). Other benefits of the infrared burners include a quick recovery during cooking (1.4 minutes) and a fast preheat (9 minutes).

This griddle showed a temperature difference of 89°F across the plate, due primarily to temperature falloff at the sides and rear of the plate. The center of the plate maintained the set temperature well. The pilots consume a large amount of energy, unnecessarily heating the plate to 200°F. Because the standing pilots consume fuel continuously, a substantial amount of energy could be saved by adding an electronic ignition.

The high productivity and the high energy efficiency under full-load conditions make this griddle well suited for high-output applications. An electronic ignition in lieu of standing pilots would conserve energy, adding even greater appeal to this appliance.

Section 5

**REFERENCES**

1. Pacific Gas and Electric Company. 1989. *Development and Application of a Uniform Testing Procedure for Griddles*. Report 008.1-89.2 prepared for the Department of Research and Development. San Ramon, California: Pacific Gas and Electric Company.
2. American Society for Testing and Materials. ASTM F 1275-90. *Standard Test Methods for the Performance of Griddles*. In *Annual Book of ASTM Standards*. Philadelphia: American Society for Testing and Materials. This test method can be purchased from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.
3. Pacific Gas and Electric Company. In progress. *U.S. Range Model RGTA-2436-1 Gas Griddle: Application of ASTM Standard Test Methods*. Report 008.1-93.7 prepared for the Department of Research and Development. San Ramon, California: Pacific Gas and Electric Company.

Appendix A  
**GLOSSARY**

## GLOSSARY

### *Cooking Energy*

Energy consumed by the griddle as it is used to cook hamburger patties under full-, half-, and light-load conditions.

### *Cooking Energy Efficiency*

The quantity of energy input to the hamburger patties, expressed as a percentage of the quantity of energy input to the griddle during the full-, half-, and light-load tests.

### *Energy Input Rate (kW or kBtu/h)*

*Energy Consumption Rate*

*Energy Rate*

The peak rate (Btu/h or kW) at which an appliance will consume energy, typically reflected during preheat.

### *Griddle*

A device for cooking food in oil or in its own juices by direct contact with a hot surface.

### *Heating Value*

*Heating Content*

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

### *Idle Energy Rate (kW or kBtu/h)*

*Idle Energy Consumption Rate*

*Idle Energy Input Rate*

*Idle Rate*

The rate of appliance energy consumption (Btu/h or kW) while it is "idling" or "holding" the cooking surface at a stabilized condition or temperature.

***Pilot Energy Consumption (kBtu)***

*Pilot Energy Use*

*Standing or Constant Pilot Energy Consumption*

*Standing or Constant Pilot Energy Use*

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

***Preheat Energy (kWh or kBtu)***

*Preheat Energy Consumption*

The amount of energy consumed (Btu/h or kW) by the griddle while preheating the cooking surface from ambient room temperature to the thermostat set point.

***Preheat Rate***

The rate at which the cooking surface heats during a preheat.

***Preheat Time (minute, hour)***

*Preheat Period*

The amount of time required for the cooking surface to preheat from ambient room temperature to the thermostat set point.

***Production Capacity***

The maximum production rate (lb/h) of the griddle when cooking hamburger patties in accordance with the full-load cooking test.

***Recovery Time***

The average time from the removal of the last hamburger patty of a load until the cooking surface is within 10°F of the set temperature and is ready to be reloaded.

***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.

***Water-Boil Efficiency (%)***

The quantity of energy required to boil water from a cooking surface, expressed as a percentage of the quantity of energy input to the griddle during the boil-off test period.

Appendix B  
**MANUFACTURER'S PRODUCT SPECIFICATIONS**

Every feature of the Keating MIRACLEAN griddle is designed to improve performance while saving you money in daily operation. The 36 x 30 griddle with two heat zone allows you to cook a breakfast, lunch or dinner menu all at the same time.

**SAVE ON ENERGY:** special properties of the MIRACLEAN plate cut energy costs dramatically. You cook for less time at lower temperatures since the heat goes directly into the food, not the kitchen. The MIRACLEAN surface reduces heat loss by 70%, so your kitchen stays cooler.

**SAVE ON LABOR:** the MIRACLEAN griddle is simple to operate and easy to clean. No more griddle brick, harsh chemicals and hours of hard work. A scraper, cool water, a palmetto brush, Keating Klenzer and 5 minutes a day is all it takes.

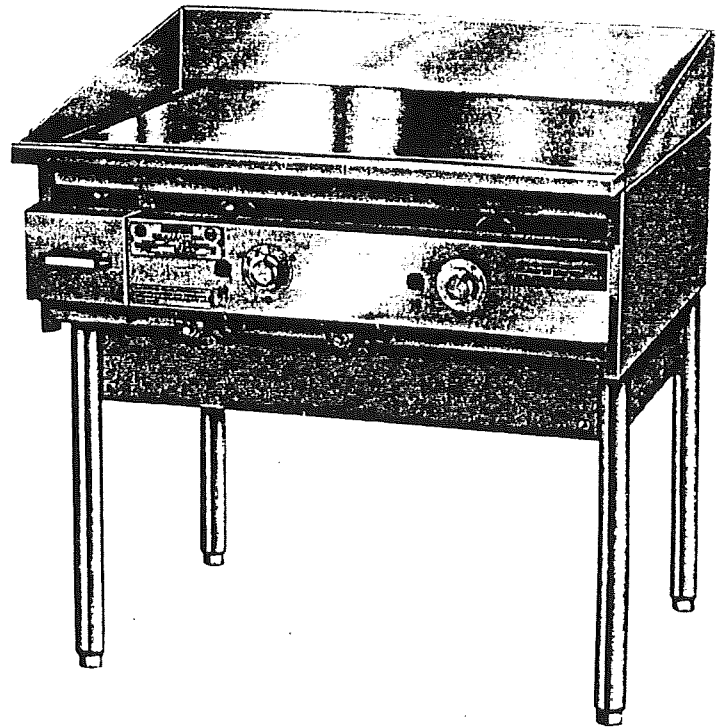
**INCREASE COOKING FLEXIBILITY:** the MIRACLEAN features zoned temperature control. Now you can cook different foods at different temperatures on the same griddle. The gas griddle has a thermostat and an ON/OFF switch for every 2 feet of griddle surface.

**IMPROVE PRODUCT APPEARANCE:** there is less food shrinkage on a MIRACLEAN. The chromium surface holds the food to the griddle plate. When the food is cooked, a releasing agent lifts the product from the surface, making it easy to remove. Portions look bigger and more appealing to your customers.

**IMPROVE FLAVOR:** after cooking on the MIRACLEAN you scrape any residue from the surface. There is no flavor transfer from the griddle to the new food product. Your eggs will taste like eggs not sausage and bacon.

**OPTIONS:** Keating has a complete line of accessories to complement your griddle. The most popular are the STREAKER, for that charbroiled look; and a cutting board and plate shelf for added counter space.

Infrared burner option is available on all griddles.



### LOW TEMPERATURE SPECIALIST

The Keating MIRACLEAN griddle cooks food faster, at lower temperatures. Unique properties of the MIRACLEAN plate conduct heat directly into the food product. Heat transfer is quick and efficient.

Conventional griddles need to be seasoned with oil. This oil combines with food particles to form an insulating layer of caramelization. They require higher cooking temperatures and longer cooking times to get the same results as on a MIRACLEAN. The MIRACLEAN griddle is easily cleaned with a scraper. It removes any build up of food particles, preventing flavor transfer and keeping your griddle at peak efficiency hour after hour, year after year.

*Serving Those Who Serve The Very Best*

# MODEL 36 x 30 GAS GRIDDLE

## DESCRIPTION

The Keating Miraclean griddle consists of a griddle plate, having a drain trough and perimeter installed in a cabinet equipped with gas burners. An automatic temperature control mechanism and 100% safety shut off are all arranged and designed for the proper cooking of food on a griddle surface.

## SPECIFICATIONS

**Griddle Plate:** is 33" x 24", made of high carbon, 3/4" steel. This hard, high carbon steel is plated with trivalent chromium and polished to a mirror finish. The Miraclean plate has an emissivity rating of approximately .078.

**Drain Trough:** is 3" on the left side and 2" across the front with a 4" x 1 1/2" drain in the left front (unless otherwise specified). The drain is located above a large grease drawer with baffles and a rear handle. The perimeter and grease trough are 14 gauge stainless steel. The perimeter is 4 1/2" high across the back with sides angling from 4 1/2" in the rear to 1/2" at the front. Sides have an exterior trim of 22 gauge stainless steel.

**Gas Burners:** are "H" shaped, atmospheric type with one burner for every 12" of linear plate surface. Each burner is manually ignited with a (piezo) igniter. The Model 36 x 30 has 2 burners with a total input of 80,000 BTU's natural gas and 50,000 BTU's LP. (The Canadian Gas Association rating for both natural and LP gas is 80,000 BTU's.)

**Cabinet:** burner(s) are enclosed in an inner cabinet with an insulation shell of 20 gauge stainless steel. The outer cabinet is made of 14 gauge steel sides and 18 gauge back and bottom.

**Thermostat:** millivolt, close range, hydraulic type, accurate to  $\pm 5^\circ\text{F}$  from 250° to 400°F. Application of this thermostat is patented by Keating.

**100% Safety Shut Off:** millivolt, thermocouple type with 100% safety shut off.

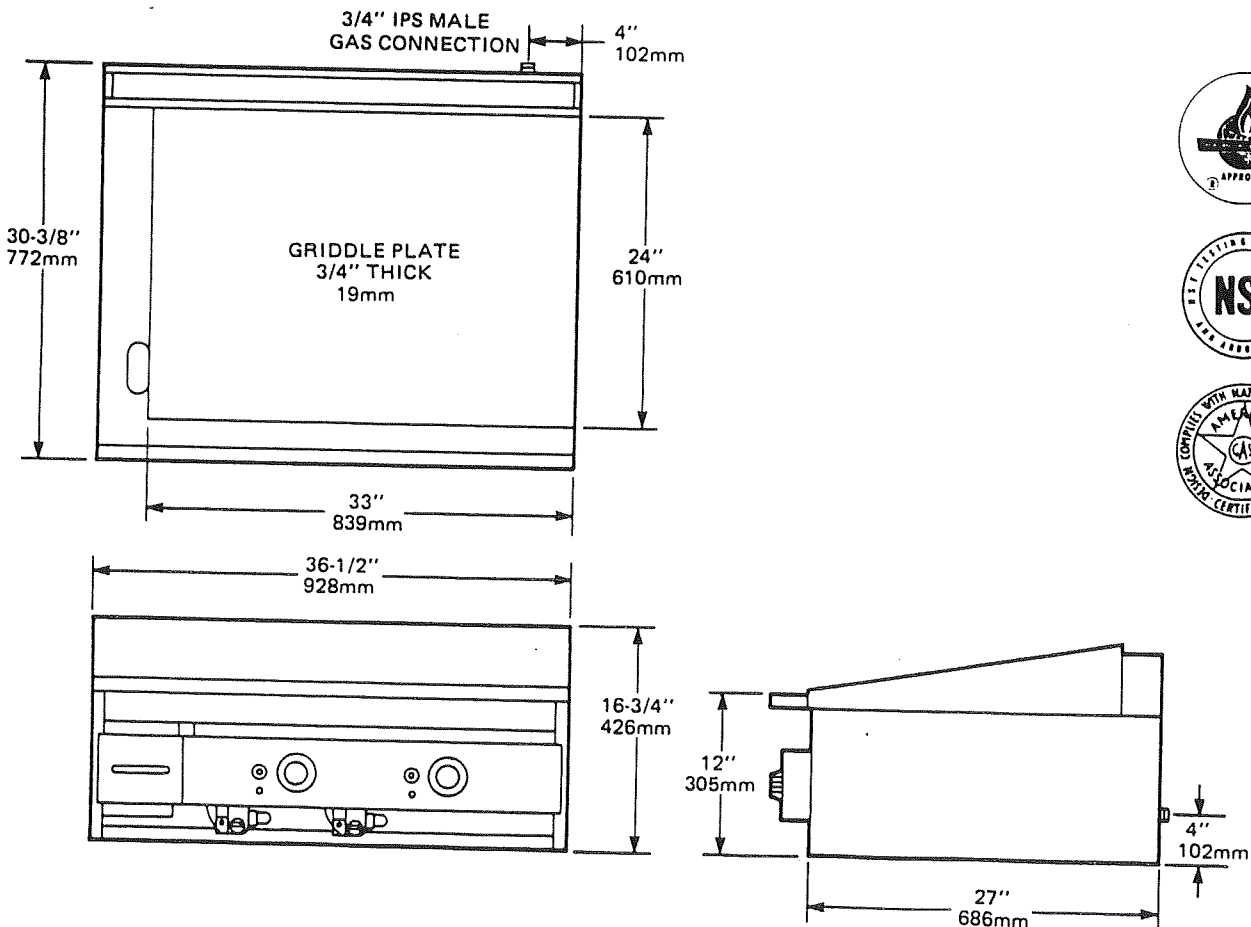
**Standard Accessories:** (1) Keating razor scraper with a packet of 10 blades; (2) one stainless steel spatula with holder; (3) one long-handle palmetto brush; (4) one can of Keating Klenzer; (5) one can of Keating Sea Powder.

**Special Order Options:** (1) standard stand; (2) stainless steel stand; (3) stand with shelf and casters; (4) thermostat seals; (5) belly bar; (6) cutting board (wood or plastic); (7) plate shelf; (8) steak covers; (9) Steak Streaker (see specification sheet); (10) custom griddle styles and configurations.

**Electric Specifications:** no electrical connections required.

**Gas Requirements:** 3/4" male IPS connection. 4" and 10" water column natural and LP gas (United States) 3 1/2" and 11" water column natural and LP gas (Canada).

Ship Wt. 410 lbs.



**KEATING**  
OF CHICAGO, INC.

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Appendix C

**COOKING ENERGY EFFICIENCY AND PRODUCTION CAPACITY VARIABLES**

## FULL-LOAD SCENARIO

February 5, 1993

Cooking Energy Efficiency	44.2%
Production Rate	48.0 lb/h
Average Recovery Time	1.4 min
Average Energy Consumption Rate	49.8 kBtu/h

Measured Values	Calculated Values
<b>Gas</b>	
Total Gas Volume (ft <sup>3</sup> )	37.90
Gas Pressure (in. H <sub>2</sub> O)	8.2
Gas Temperature (°F)	87
Heating Value (Btu/ft <sup>3</sup> )	1,022.8
Barometer (psi)	14.515
<b>Hamburger</b>	
Cook Time (min)	6.0
Total Test Time (min)	44.67
Weight Loss (%)	35.9
Total Burger Weight (lb)	35.7
Initial Fat (%)	22.3
Initial Moisture (%)	58.3
Final Moisture (%)	48.9
Initial Burger Temperature (°F)	0
Final Burger Temperature (°F)	158.5
<b>Gas</b>	
Gas Pressure (psia)	0.30
Gas Temperature (°R)	546.67
Pressure Correction Factor	1.006
Temperature Correction Factor	0.951
Total Energy to Griddle (Btu)	37,052
Energy to Griddle (Btu/lb)	1,038
<b>Hamburger</b>	
Final Weight of Water (lb)	11.2
Weight of Water Vaporized (lb)	9.6
Weight of Fat (lb)	8.0
Weight of Solids (lb)	6.9
Final Burger Weight (lb)	22.9
Initial Weight of Water (lb)	20.8
Sensible to Ice (Btu)	333
Sensible to Water (Btu)	2,634
Sensible to Fat (Btu)	505
Sensible to Solids (Btu)	220
Latent - Water Fusion (Btu)	2,998
Latent - Fat Fusion (Btu)	350
Latent - Water Vaporization (Btu)	9,337
Total Energy to Food (Btu)	16,376
Energy to Food (Btu/lb)	459
<b>Assumed Values</b>	
<b>Gas</b>	
Standard Temperature (°R)	519.67
Standard Pressure (psia)	14.73
<b>Hamburger</b>	
Specific Heat of Ice (Btu/lb, °F)	0.50
Specific Heat of Fat (Btu/lb, °F)	0.40
Specific Heat of Solids (Btu/lb, °F)	0.20
Latent Heat of Fusion, Water (Btu/lb)	144
Latent Heat of Fusion, Fat (Btu/lb)	44
Latent Heat of Vaporization, Water (Btu/lb)	970

## HALF-LOAD SCENARIO<sup>1</sup>

February 5, 1993

Cooking Energy Efficiency	36.6%
Production Rate	25.0 lb/h
Average Recovery Time	1.4 min
Average Energy Consumption Rate	29.9 kBtu/h

Measured Values	Calculated Values
<b>Gas</b>	
Total Gas Volume (ft <sup>3</sup> )	21.87
Gas Pressure (in. H <sub>2</sub> O)	8.2
Gas Temperature (°F)	87
Heating Value (Btu/ft <sup>3</sup> )	1,022.8
Barometer (psi)	14.515
<b>Hamburger</b>	
Cook Time (min)	5.75
Total Test Time (min)	42.92
Weight Loss (%)	34.6
Total Burger Weight (lb)	17.9
Initial Fat (%)	22.3
Initial Moisture (%)	58.3
Final Moisture (%)	50.7
Initial Burger Temperature (°F)	0
Final Burger Temperature (°F)	155
<b>Gas</b>	
Gas Pressure (psia)	0.30
Gas Temperature (°R)	546.67
Pressure Correction Factor	1.006
Temperature Correction Factor	0.951
Total Energy to Griddle (Btu)	21,381
Energy to Griddle (Btu/lb)	1,197
<b>Hamburger</b>	
Final Weight of Water (lb)	5.9
Weight of Water Vaporized (lb)	4.5
Weight of Fat (lb)	4.0
Weight of Solids (lb)	3.5
Final Burger Weight (lb)	11.7
Initial Weight of Water (lb)	10.4
Sensible to Ice (Btu)	167
Sensible to Water (Btu)	1,281
Sensible to Fat (Btu)	247
Sensible to Solids (Btu)	107
Latent - Water Fusion (Btu)	1,499
Latent - Fat Fusion (Btu)	175
Latent - Water Vaporization (Btu)	4,359
Total Energy to Food (Btu)	7,835
Energy to Food (Btu/lb)	439
<b>Assumed Values</b>	
<b>Gas</b>	
Standard Temperature (°R)	519.67
Standard Pressure (psia)	14.73
<b>Hamburger</b>	
Specific Heat of Ice (Btu/lb,°F)	0.50
Specific Heat of Fat (Btu/lb,°F)	0.40
Specific Heat of Solids (Btu/lb,°F)	0.20
Latent Heat of Fusion, Water (Btu/lb)	144
Latent Heat of Fusion, Fat (Btu/lb)	44
Latent Heat of Vaporization, Water (Btu/lb)	970

<sup>1</sup>Both thermostats were turned on.

# LIGHT-LOAD SCENARIO<sup>1</sup>

February 5, 1993

Cooking Energy Efficiency	16.1%
Production Rate	7.3 lb/h
Average Recovery Time	1.9 min
Average Energy Consumption Rate	19.8 kBtu/h

Measured Values	Calculated Values
<b>Gas</b>	
Total Gas Volume (ft <sup>3</sup> )	15.43
Gas Pressure (in. H <sub>2</sub> O)	8.2
Gas Temperature (°F)	87
Heating Value (Btu/ft <sup>3</sup> )	1,022.8
Barometer (psi)	14.515
<b>Hamburger</b>	
Cook Time (min)	5.75
Total Test Time (min)	45.65
Weight Loss (%)	33.9
Total Burger Weight (lb)	5.6
Initial Fat (%)	22.3
Initial Moisture (%)	58.3
Final Moisture (%)	51.1
Initial Burger Temperature (°F)	0
Final Burger Temperature (°F)	156
<b>Gas</b>	
Gas Pressure (psia)	0.30
Gas Temperature (°R)	546.67
Pressure Correction Factor	1.006
Temperature Correction Factor	0.951
Total Energy to Griddle (Btu)	15,085
Energy to Griddle (Btu/lb)	2,699
<b>Hamburger</b>	
Final Weight of Water (lb)	1.9
Weight of Water Vaporized (lb)	1.4
Weight of Fat (lb)	1.2
Weight of Solids (lb)	1.1
Final Burger Weight (lb)	3.7
Initial Weight of Water (lb)	3.3
Sensible to Ice (Btu)	52
Sensible to Water (Btu)	404
Sensible to Fat (Btu)	78
Sensible to Solids (Btu)	34
Latent - Water Fusion (Btu)	469
Latent - Fat Fusion (Btu)	55
Latent - Water Vaporization (Btu)	1,331
Total Energy to Food (Btu)	2,423
Energy to Food (Btu/lb)	433
Assumed Values	
<b>Gas</b>	
Standard Temperature (°R)	519.67
Standard Pressure (psia)	14.73
<b>Hamburger</b>	
Specific Heat of Ice (Btu/lb,°F)	0.50
Specific Heat of Fat (Btu/lb,°F)	0.40
Specific Heat of Solids (Btu/lb,°F)	0.20
Latent Heat of Fusion, Water (Btu/lb)	144
Latent Heat of Fusion, Fat (Btu/lb)	44
Latent Heat of Vaporization, Water (Btu/lb)	970

<sup>1</sup>Both thermostats were turned on.