Garland CG-36R Gas Griddle
Performance Test

Application of ASTM Standard
Test Method F 1275-99

FSTC Report 5011.02.05

Food Service Technology Center
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Prepared by:

David Cowen
David Zabrowski
Fisher-Nickel Inc.

Contributors:

Scott Miner
Greg Sorensen
Fisher-Nickel Inc.

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Executive Summary

Griddles are widely used throughout the hospitality industry to prepare a variety of menu items, from pancakes to hamburgers. As concern over food safety continues, griddle performance parameters such as temperature uniformity and productivity are becoming more important to the food service operator.

Garland's CG 36R griddle features an all stainless steel construction, electronic thermostats with embedded sensors in the one-inch thick polished cooking surface. A unique design places the grease trough at the back of the griddle cooking surface. Food Service Technology Center (FSTC) engineers tested the 3-foot griddle under the tightly controlled conditions of the American Society for Testing and Materials' (ASTM) Standard Test Method for the Performance of Griddles.[1] Griddle performance is characterized by temperature uniformity, preheat time and energy consumption, idle energy consumption rate, cooking energy efficiency, and production capacity.

Cooking energy efficiency and production capacity was determined by cooking frozen hamburgers under three different loading scenarios (heavy—24 hamburgers, medium—12 hamburgers, and light—4 hamburgers). The cook time for each of the loading scenarios was 7¾ minutes. Production capacity includes the cooking time and the time required for the cooking surface to return within 25°F of the thermostat setpoint.

[1] American Society for Testing and Materials. 1995. *Standard Test Method for the Performance of Griddles.* ASTM Designation F 1275-95, in *Annual Book of ASTM Standards,* Philadelphia.

Executive Summary

Cooking energy efficiency is a measure of how much of the energy that an appliance consumes is actually delivered to the food product during the cooking process. Cooking energy efficiency is therefore defined by the following relationship:

$$\text{Cooking Energy Efficiency} = \frac{\text{Energy to Food}}{\text{Energy to Griddle}}$$

A summary of the ASTM test results is presented in Table ES-1.

Table ES-1. Summary of Griddle Performance.

Rated Energy Input Rate (Btu/h)	90,000
Measured Energy Input Rate (Btu/h)	85,980
Temperature Uniformity (°F) [a]	± 17
Preheat Time to 375°F (min)	13.27
Preheat Energy to 375°F (Btu)	18,780
Idle Energy Rate @ 375°F (Btu/h)	17,465
Extra-heavy load Cooking Energy Efficiency (%)	44.7 ± 1.4
Heavy-Load Cooking Energy Efficiency (%)	40.7 ± 0.1
Medium-Load Cooking Energy Efficiency (%)	30.0 ± 1.4
Light-Load Cooking Energy Efficiency (%)	12.6 ± 0.7
Production Capacity [b] (lb/h)	46.2 ± 1.0
Cooking Surface Recovery Time [b] (min)	< 1.0

[a] Temperature uniformity reflects the absolute temperature variance across the cooking surface to within 3 inches from each edge.

[b] Based on the heavy-load cooking test with a minimum 30-second preparation time between loads.

Figure ES-1 illustrates the relationship between cooking energy efficiency and production rate for this griddle. Griddle production rate is a function of both the hamburger patty cook time and the cooking surface recovery time.

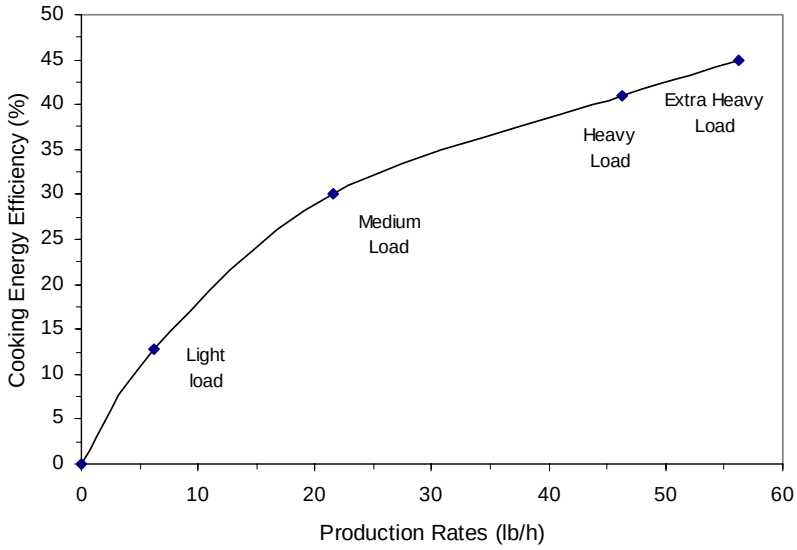
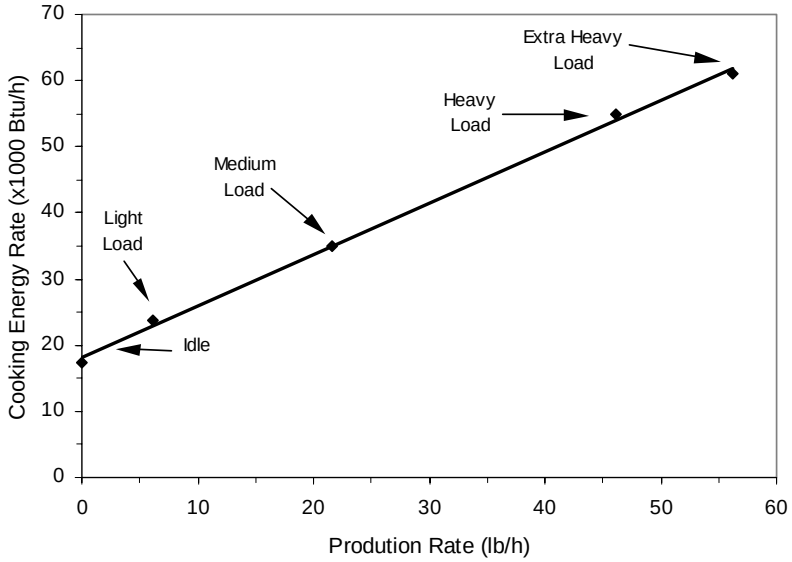


Figure ES-1. Griddle part-load cooking energy efficiency.

Figure ES-2 illustrates the relationship between the griddle's average energy consumption rate and the production rate. This graph can be used as a tool to estimate the daily energy consumption and probable demand for the griddle in a real-world operation. Average energy consumption rates at 10, 20, and 30 pounds per hour are 25,490 Btu/h, 33,340 Btu/h, and 41,200 Btu/h, respectively. For an operation cooking an average of 20 pounds of food per hour over the course of the day (e.g., 200 pounds of food over a ten hour day), the average energy consumption for this griddle would be 33,340 Btu/h.

Garland's CG 36R gas griddle exhibited a competitive cooking energy efficiency (40.7%) under heavy-load testing, and its production capacity (46.2 lb/h per the ASTM test method) was among the highest for any 3-foot griddle tested at the Food Service Technology Center. Garland's CG 36R griddle showed under heavy load testing that it had the capacity to handle an optional extra-heavy load test. The optional extra-heavy load test calls for one patty per nominal five inches of griddle cooking surface. Under the extra-heavy

load test the griddle's cooking energy efficiency improved to 44.7% and its production capacity increased by 22% (to 56.21 lb/h). The ability to handle an extra-heavy load is attractive for an end user with a high volume operation.



Note: Light-load = 4 hamburgers/load; medium-load = 12 hamburgers/load; heavy-load = 24 hamburgers/load; extra-heavy load = 30 hamburgers/load.

Figure ES-2. Griddle cooking energy consumption profile.

1 Introduction

Background

Griddles are used throughout the hospitality industry to prepare a variety of menu items such as pancakes and hamburgers. An operator shopping for a new griddle looks for energy usage, uniformity of cooking surface temperature, and amount of food that can be cooked in a given period of time.

With support from the Electric Power Research Institute (EPRI), the Gas Technology Institute (GTI), and the National Restaurant Association, the Food Service Technology Center (FSTC) developed a uniform testing procedure to evaluate the performance of gas and electric griddles. This test procedure was submitted to the American Society for Testing and Materials (ASTM), and it was accepted as a standard test method (Designation F 1275-90) in January 1990.[1] The FSTC Report, *Development and Application of a Uniform Testing Procedure for Griddles* documents the developmental procedures and test results of several gas and electric griddles.[2]

In keeping with ASTM's policy that a document be periodically reviewed, the FSTC re-evaluated the griddle test method and suggested various simplifications. The test method was subsequently updated in 1999 (*new* Designation F 1275-99). Other FSTC reports document results of applying the revised version of the ASTM test method and discuss the scope of these revisions.[3,4,5,6,7,8,9]

Garland's CG 36R griddle features an all stainless steel construction, electronic thermostats with embedded sensors in the 1" thick polished griddle cooking surface. The CG 36R gas griddle by Garland was tested according to the ASTM procedure, and this report documents the results.

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

Introduction

Objectives

The objective of this report is to examine the operation and performance of the Garland gas griddle, model CG 36R 01, under the controlled conditions of the ASTM standard test method. The scope of this testing is as follows:

1. Verify that the appliance is operating at the manufacturer's rated energy input.
2. Document the temperature uniformity of the cooking surface and the accuracy of the thermostats.
3. Determine the time and energy required to preheat the cooking surface from room temperature to 375°F.
4. Characterize the idle energy use with the thermostats set at a calibrated 375°F.
5. Document the cooking energy consumption and efficiency under three hamburger loading scenarios: heavy (24 patties), medium (12 patties), and light (4 patties).
6. Determine the production capacity and cooking surface temperature recovery time during the heavy-load test.

Appliance Description

Garland's CG-36R gas griddle features three electronic thermostats with sensors imbedded in the griddle plate. Each thermostat controls a 30,000 Btu/h U-shaped burner—one burner for every twelve inches of griddle surface. The cooking surface is one-inch thick polished finish steel surrounded by stainless steel splashguards and back splash. The griddle's grease trough is located in the back with a contoured grease opening. The control panel contains indicator lights for the electronic main power switch, electronic thermostat switches (all three burners) and gas pilot ignition.

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

Table 1-1. Appliance Specifications.

Manufacturer	Garland
Model	CG 36R
Generic Appliance Type	Electronically Controlled Thermostatic Griddle
Rated Input	90,000 Btu
Dimensions	36” x 39” x 19”
Construction	1”-thick stainless steel
Controls	Electronic thermostats temperature control adjustable from 150 to 450°F with ignition indicator lights.

2 Methods

Setup and Instrumentation

FSTC researchers installed the griddle on a tiled floor under a 4-foot-deep canopy hood that was 6 feet, 6 inches above the floor. The hood operated at a nominal exhaust rate of 300 cfm per linear foot of hood. There was at least 6 inches of clearance between the vertical plane of the griddle and the edge of the hood. All test apparatus were installed in accordance with Section 9 of the ASTM test method.[1]

Researchers instrumented the griddle with thermocouples to measure cooking surface temperatures. For the temperature uniformity test, 35 thermocouples were welded to the cooking surface in a grid pattern (see Figure 2-1). Three thermocouples (one at the center of each linear foot of griddle plate—Figure 2-2) were used for the remainder of the tests.

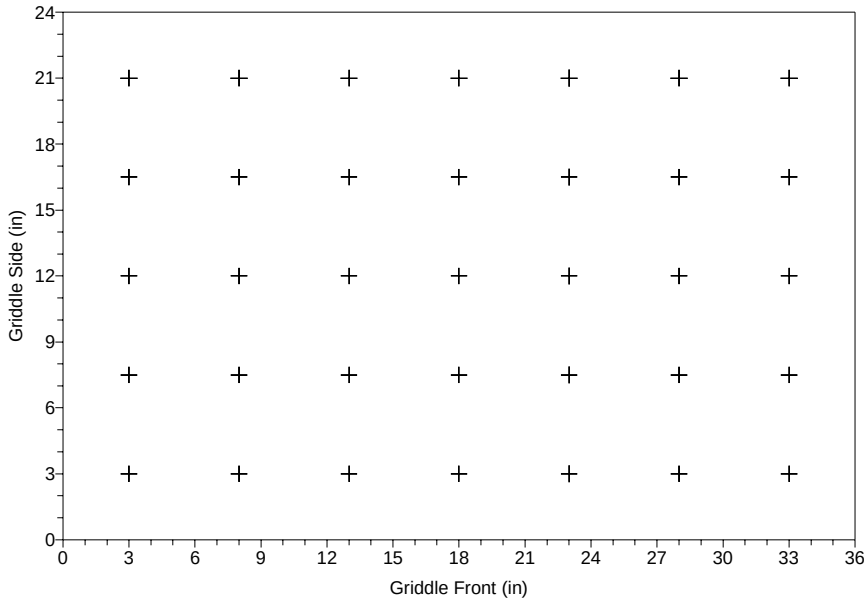


Figure 2-1.
Thermocouple grid for temperature uniformity test.

Methods

Natural gas consumption was measured using a positive displacement-type gas meter that generated a pulse every 0.1 ft^3. The gas meter and the thermocouples were connected to an automated data acquisition unit that recorded data every 5 seconds. A chemical laboratory used a gas chromatograph to determine the gas heating value on each day of testing. All gas measurements were corrected to standard conditions.

Measured Energy Input Rate

Researchers determined the energy input rate by measuring the energy consumption during a preheat from room temperature. The maximum power draw during this period was reported as the measured energy input rate.

Cooking Tests

Researchers specified frozen, 20% fat, quarter-pound hamburger patties for all cooking tests. Each load of hamburgers was cooked to a 35% weight loss. The cooking tests involved "barreling" six loads of frozen hamburger patties; cooking surface temperature was used as a basis for recovery (see Figure 2-2). Each test was followed by a 1-hour wait period and was then repeated two more times. Researchers tested the griddle using 24 patties (heavy load), 12 patties (medium load), and 4 patties (light load).

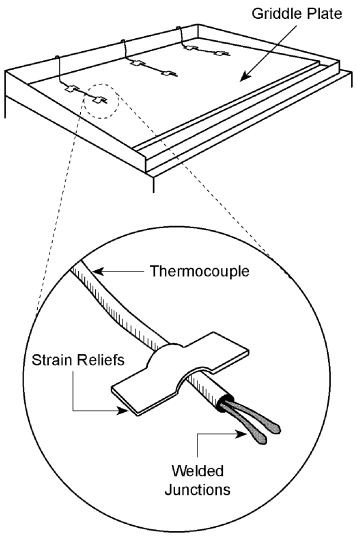


Figure 2-2. Thermocouple placement for testing.

Due to the logistics involved in removing one load of cooked hamburgers and placing another load onto the griddle, a minimum preparation time of 30 seconds (based on 10 seconds per linear foot) was incorporated into the cooking procedure. This ensures that the cooking tests are uniformly applied from laboratory to laboratory. Griddle recovery was then based on the cooking surface reaching a threshold temperature of 350°F (measured at the center of each linear foot of griddle plate). Reloading within 25°F of the 375°F thermostat set point does not significantly lower the average cooking surface over the cooking cycle, nor does it extend the cook time. The griddle was reloaded either after all three thermocouples reached the threshold temperature, or 30 seconds after removing the previous load from the griddle, whichever was longer.

Prior to the six-load test, one to two loads of hamburgers were cooked to stabilize the griddle response. Energy consumption, elapsed time, and the average weight loss of the hamburger patties were recorded during the final six loads of the cooking test. After removing the last load and allowing the griddle to recover, researchers terminated the test.

Cooking tests were run in the following sequence: three replicates of the heavy-load test, three replicates of the medium-load test, and three replicates of the light-load test. This procedure ensured that the reported cooking energy efficiency and production capacity results had an uncertainty of less than ±10%. The results from each test run were averaged, and the absolute uncertainty was calculated based on the standard deviation of the results.

The ASTM results reporting sheets appear in Appendix C.

3 Results

Energy Input Rate

Prior to testing, the energy input rate was measured and compared with the manufacturer's nameplate value. This procedure ensured that the griddle was operating within its specified parameters. The measured energy input rate was 85,980 Btu/h (a difference of 4.47% from the nameplate rating).

Temperature Uniformity

Thermocouples were welded to the cooking surface at the center of each linear foot to facilitate temperature calibration. The thermostat control was turned to a ~ 375°F setting. The thermocouples were then monitored after the griddle had stabilized at the set temperature for one hour. Researchers manually adjusted the control to maintain an average of 375 ± 5°F on the cooking surface at the center of each linear foot.

To characterize the temperature profile of the cooking surface at 375°F, researchers welded additional thermocouples to the cooking surface in a 35-point grid with approximately 5 inches between adjacent points. Griddle temperatures were monitored for one hour after the cooking surface had stabilized at a calibrated 375°F. The temperature sensing points are illustrated in Figure 3-1 and the resulting temperature profile is presented in Figure 3-2. The results from these temperature uniformity tests are summarized in Table 3-1.

Results

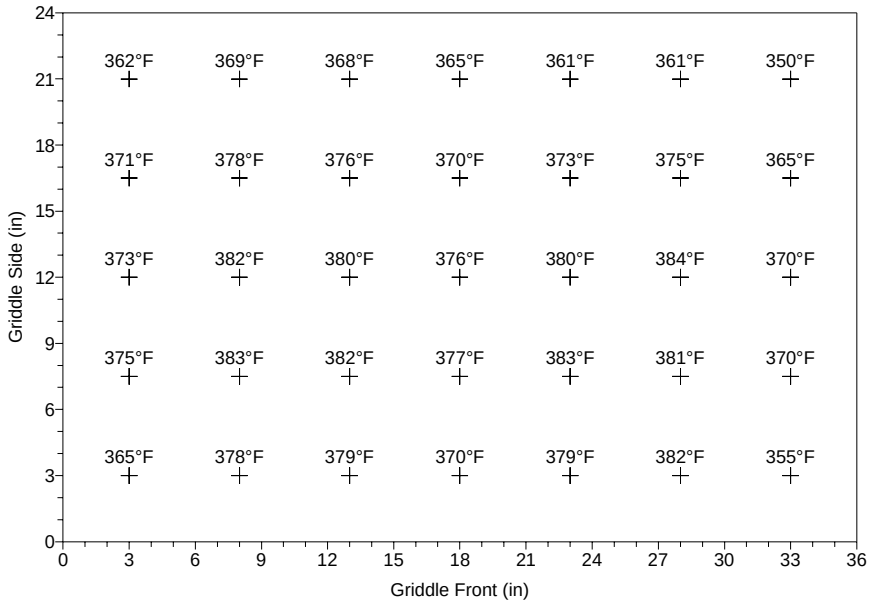


Figure 3-1.

Temperature sensing points on the griddle surface.

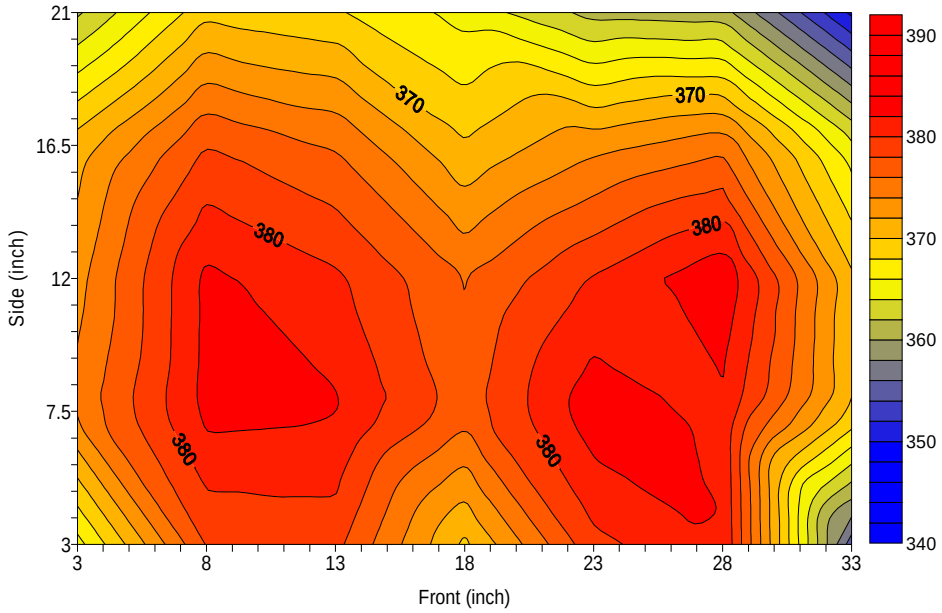


Figure 3-2.

Temperature map of the cooking surface.

Results

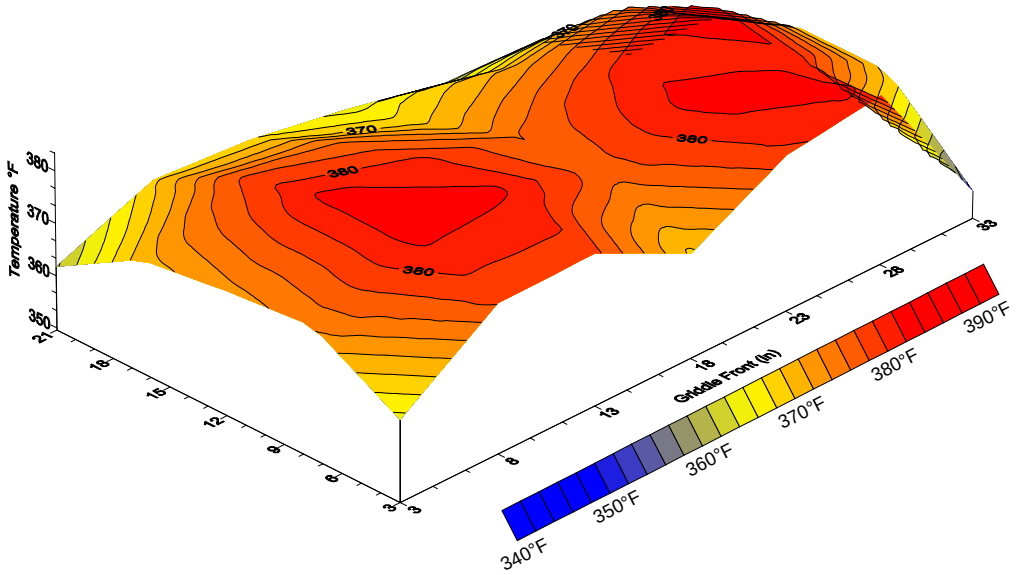


Table 3-1. Temperature Uniformity and Thermostat Accuracy.

Control Settings: [a]	
Left Control (°F)	378
Center Control (°F)	375
Right Control (°F)	376
Average Surface Temperature (°F)	373
Maximum Temperature Difference Across Plate (°F)	34
Standard Deviation of Surface Temperatures (°F)	9

[a]Thermostat accuracy is the control setting required to maintain 375 ± 5°F on the cooking surface directly above the thermostat sensor.

Preheat and Idle Tests

Preheat Energy and Time

Researchers removed the additional thermocouples, leaving only the points at the center of each linear foot. The cooking surface temperature was an average of 74°F at the outset of the preheat test. Researchers measured the energy consumption and time required to preheat the cooking surface to a calibrated 375°F. The griddle's preheat required 18,780 Btu and 13.27 minutes. Figure 3-3 shows the energy consumption rate in conjunction with the cooking surface temperature during the preheat test.

Idle Energy Rate

The griddle was allowed to stabilize at 375°F for one hour. Researchers then monitored the energy consumption over a 2-hour period. The idle energy rate during this period was 17,465 Btu/h.

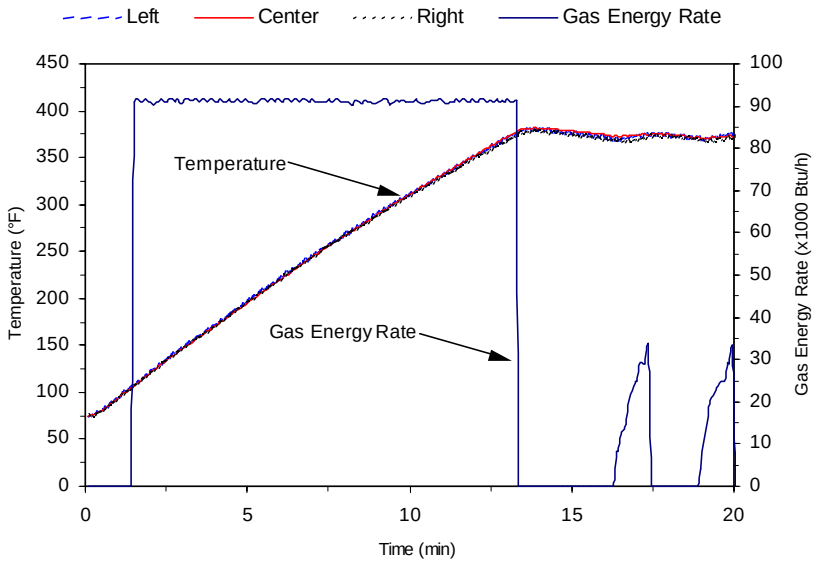


Figure 3-3.
Preheat characteristics.

Results

Test Results

Input, preheat, and idle test results are summarized in Table 3-2.

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

Rated Energy Input Rate (Btu/h)	90,000
Measured Energy Input Rate (Btu/h)	85,980
Percentage Difference (%)	4.47
Preheat	
Time to 375°F (min)	13.27
Energy (Btu)	18,780
Rate to 375°F (°F/min)	22.8
Idle Energy Rate @ 375°F (Btu/h)	17,465

Cooking Tests

The griddle was tested under three loading scenarios: heavy (24 hamburger patties), medium (12 hamburger patties), and light (4 hamburger patties). The hamburgers used for the cooking tests consisted of 20% fat and approximately 60% moisture, as specified by the ASTM procedure. Researchers monitored hamburger patty cook time and weight loss, cooking surface recovery time, and griddle energy consumption during these tests.

Heavy-Load Tests

The heavy-load cooking tests were designed to reflect a griddle's maximum performance. The griddle was used to cook six loads of 24 frozen hamburger patties—one load after the other, similar to a batch-cooking procedure. Figure 3-4 shows the average cooking surface temperature during a heavy-load test. One load was used to stabilize the griddle, and six loads were used to calculate cooking energy efficiency and production capacity.

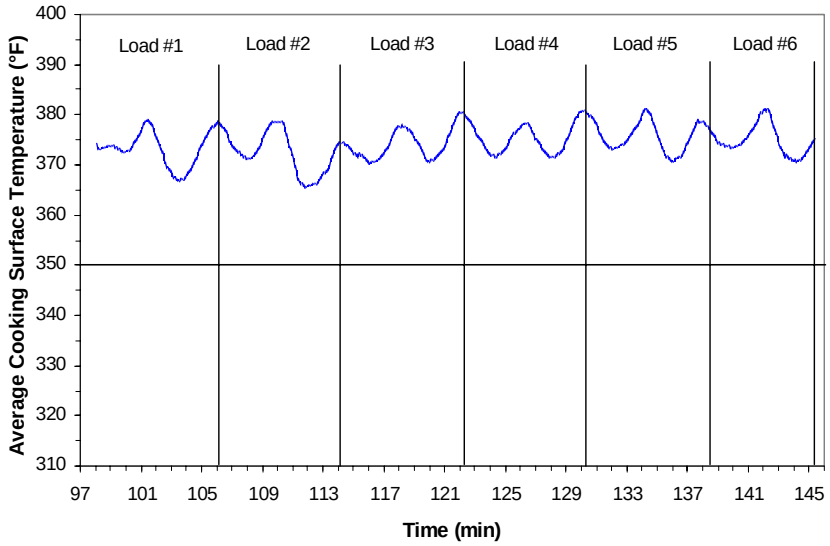


Figure 3-4.
Average cooking surface temperature during a heavy-load test.

During heavy-load testing researchers noticed the immediate recovery of the griddle cooking surface. Since the griddle was showing a recovered surface temperature after the removal and scraping of the heavy-loads, researchers attempted an extra-heavy load test on the griddle by adding six more patties. The 36" by 24" cooking surface allowed 30 hamburger patties to be cooked at a time. Figure 3-5 illustrates griddle testing under extra-heavy load conditions.

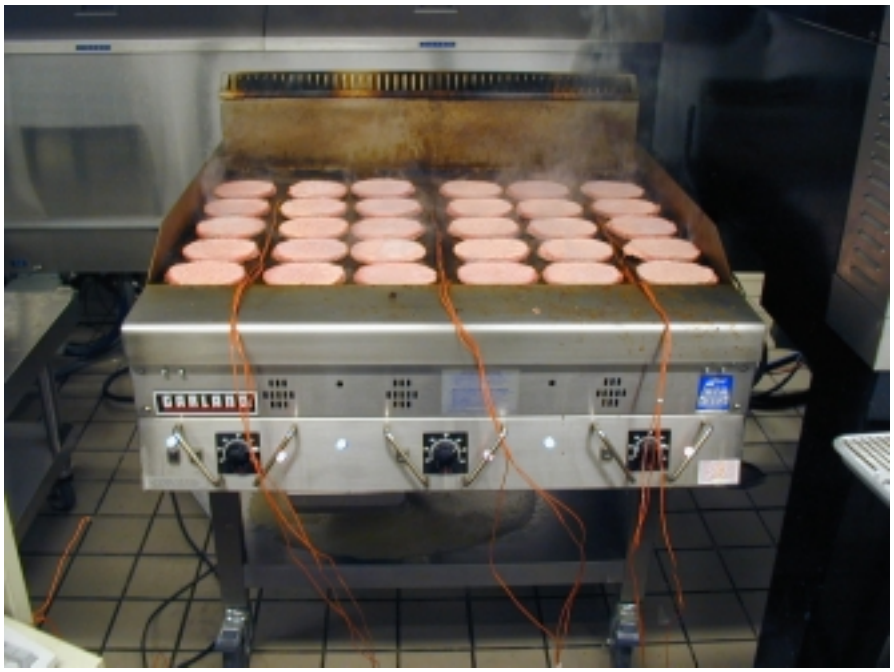


Figure 3-5.
Extra-heavy load cooking on the Garland griddle.

The extra-heavy load tests showed enhanced performance over the ASTM heavy-load tests. Filling up the griddle increased the cooking energy efficiency by 10% (44.7% vs. 40.7%) and produced 17% more hamburgers (56.2 lb/h vs. 46.2 lb/h). Table 3-3 summarizes the test results for the heavy- and extra-heavy load tests.

Figure 3-6 illustrates the griddle's temperature response while a heavy load of frozen hamburger patties was being cooked. Production capacity includes the time required for the cooking surface to recover to 350°F (recovery time). Production rate varies with the amount of food being cooked at one time.

Table 3-3. Heavy-Test Results.

	Heavy Load	Extra Heavy Load
Hamburger Patty Cook Time (min)	6.8	7.0
Average Recovery Time (min)	< 1.0	1.0
Production Rate (lb/h)	46.2 ± 1.0	56.2 ± 0.1
Energy Consumption (Btu/lb)	1,188	1,086
Cooking Energy Rate (Btu/h)	54,842	61,051
Cooking Energy Efficiency (%)	40.7 ± 0.1	44.7 ± 1.4

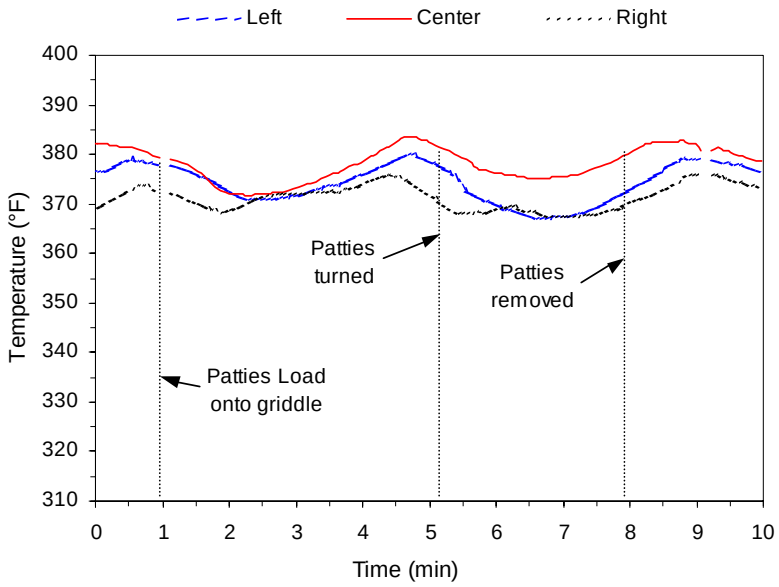


Figure 3-6.
Griddle temperatures while cooking a heavy load.

Medium- and Light-Load Tests

Medium- and light-load tests represent a more typical usage pattern for a griddle in cook-to-order applications. Since a griddle is seldom fully loaded in many food service establishments, these part-load efficiencies can be used to estimate griddle performance in an actual operation.

Both the medium- and light-load tests were conducted on the left half of the cooking surface. Since the entire griddle was heated to 375°F, the energy consumed during these part-load tests includes radiant heat losses from the unused half of the griddle. Cooking energy efficiencies at 21.6 (medium) and 6.2 (light) pounds per hour were 30.0% and 12.6%, respectively.

Test Results

Energy imparted to the hamburger patties was calculated by separating the various components of the patties (water, fat, and solids) and determining the amount of heat gained by each component (Appendix D). The griddle's cooking energy efficiency for a given loading scenario is the amount of energy imparted to the hamburger patties, expressed as a percentage of the amount of energy consumed by the griddle during the cooking process.

Cooking energy efficiency results for the heavy-load tests were 40.7%, 40.7%, and 40.7%, yielding a maximum uncertainty of 0.1% in the test results. Table 3-4 summarizes the results of the ASTM cooking energy efficiency and production capacity tests.

Figure 3-7 illustrates the relationship between cooking energy efficiency and production rate for this griddle. Griddle production rate is a function of both the hamburger patty cook time and the cooking surface recovery time. Appendix D contains a synopsis of test data for each replicate of the cooking tests.

Table 3-4. Cooking Energy Efficiency and Production Capacity Test Results.

	Heavy Load	Medium Load	Light Load
Hamburger Patty Cook Time (min)	6.8	7.70	9.27
Average Recovery Time (min)	< 1.0	< 1.0	< 1.0
Production Rate (lb/h)	46.2 ± 1.0	21.6 ± 0.2	6.20 ± 0.5
Energy Consumption (Btu/lb)	1,188	1,619	3,837
Cooking Energy Rate (Btu/h)	54,842	35,008	23,763
Cooking Energy Efficiency (%)	40.7 ± 0.1	30.0 ± 1.4	12.6 ± 0.7

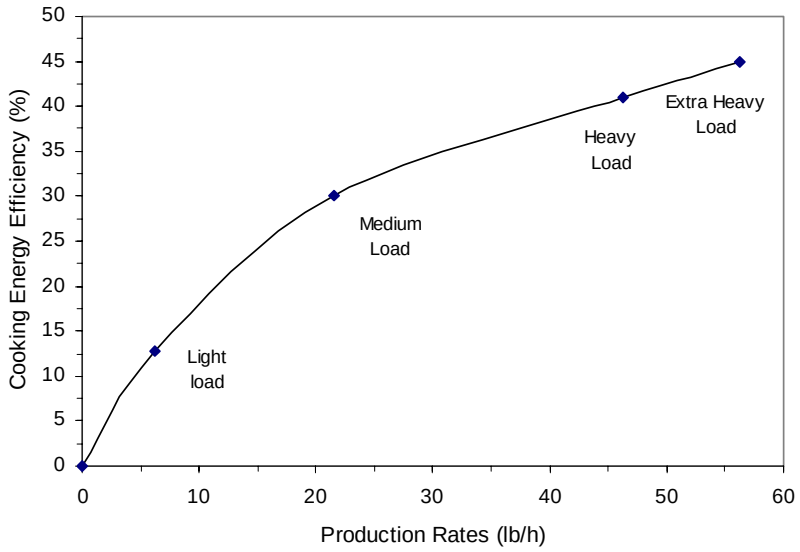


Figure 3-7. Griddle part-load cooking energy efficiency.

Figure 3-8 illustrates the relationship between the griddle's average energy consumption rate and the production rate. This graph can be used as a tool to estimate the daily energy consumption and average energy rate for the griddle in a real-world operation. Average energy consumption rates at 10, 20, and 30 pounds per hour are 25,490 Btu/h, 33,340 Btu/h, and 41,200 Btu/h, respectively. For an operation cooking an average of 20 pounds of food per hour over the course of the day (e.g., 200 pounds of food over a ten hour day), the average energy consumption rate for this griddle would be 33,340 Btu/h.

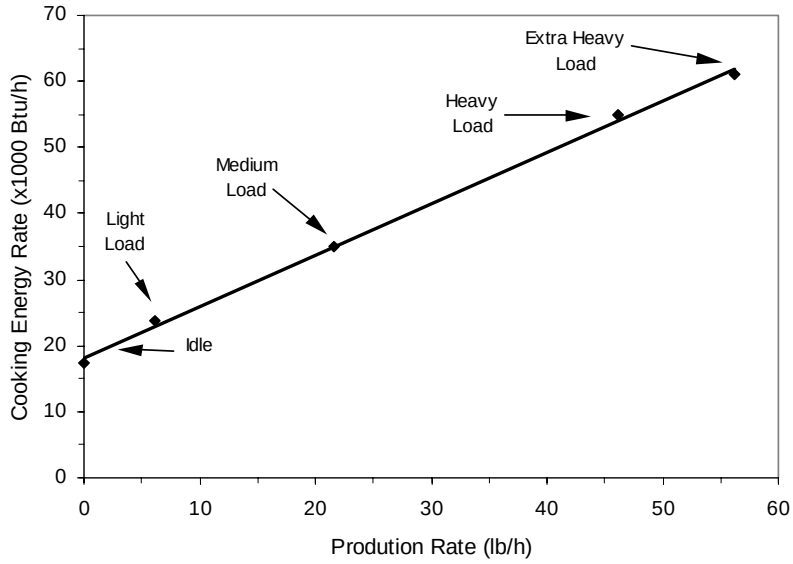


Figure 3-8. Griddle cooking energy consumption profile.

Note: Light-load = 4 hamburgers/load; medium-load = 12 hamburgers/load; heavy-load = 24 hamburgers/load; extra-heavy load = 30 hamburgers/load.

4 Conclusions

The Garland CG-36R gas griddle performed well under the rigorous conditions of the ASTM test method, particularly with respect to the cooking tests. The griddle exhibited competitive cooking energy efficiency under heavy-load conditions (40.7%), while displaying one of the highest production capacities (46.2 pounds per hour) for a 3-foot griddle tested to date at the Food Service Technology Center.[2,3,4,5,6,7,8]

Not only was this Garland gas griddle a high-production unit, but it also displayed exceptional temperature uniformity, maintaining the temperature to within ± 17°F of setpoint everywhere on the cooking surface. In fact, this is one of the most uniform griddles tested at the FSTC.

The griddle's quick 13.3-minute preheat means that an operator won't have to wait long for the griddle to be ready to cook in the morning. However, the idle rate was at the high end of the scale, bringing down the griddle's part-load efficiency.

During the heavy-load tests, researchers noticed that approximately 15% of the cooking surface remained unused. Since the griddle recovered quickly during these tests and the cooking surface was deep enough to accommodate an extra row of patties, researchers attempted a series of extra-heavy load tests on the griddle. The griddle comfortably cooked a 30-patty load, resulting in improved performance (44.7% vs. 40.7% cooking energy efficiency). These extra-heavy load tests resulted in a 17% increase in production capacity (56.2 lb/h vs. 46.2 lb/h), rivaling that of many larger griddles. [6]

With its quick recovery and uniform temperature, this Garland griddle is well suited for high production operations.

5 References

1. American Society for Testing and Materials. 1995. *Standard Test Method for the Performance of Griddles.* ASTM Designation F 1275-95, in *Annual Book of ASTM Standards,* Philadelphia.

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Appendixes

A Glossary

Cooking Energy (kWh or kBtu)

The total energy consumed by an appliance as it is used to cook a specified food product.

Cooking Energy Consumption Rate
(kW or kBtu/h)

The average rate of energy consumption during the cooking period.

Cooking Energy Efficiency (%)

The quantity of energy input to the food products; expressed as a percentage of the quantity of energy input to the appliance during the heavy-, medium-, and light-load tests.

Duty Cycle (%)
Load Factor

The average energy consumption rate (based on a specified operating period for the appliance) expressed as a percentage of the measured energy input rate.

$$\text{Duty Cycle} = \frac{\text{Average Energy Consumption Rate}}{\text{Measured Energy Input Rate}} \times 100$$

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 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.

Idle Energy Rate (kW or Btu/h)
Idle Energy Input Rate
Idle Rate

The rate of appliance energy consumption while it is "idling" or "holding" at a stabilized operating condition or temperature.

Idle Temperature (°F, Setting)

The temperature of the cooking cavity/surface (selected by the appliance operator or specified for a controlled test) that is maintained by the appliance under an idle condition.

Idle Duty Cycle (%)
Idle Energy Factor

The idle energy consumption rate expressed as a percentage of the measured energy input rate.

$$\text{Idle Duty Cycle} = \frac{\text{Idle Energy Consumption Rate}}{\text{Measured Energy Input Rate}} \times 100$$

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 appliance preheat (i.e., the period of

operation when all burners or elements are "on").

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 thermostats or control knobs have been turned off by the food service operator).

Preheat Energy (kWh or Btu)
Preheat Energy Consumption

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

Preheat Rate (°F/min)

The rate at which the cook zone heats during a preheat.

Preheat Time (minute)
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.

Production Capacity (lb/h)

The maximum production rate of an appliance while cooking a specified food product in accordance with the heavy-load cooking test.

Production Rate (lb/h)
Productivity

The average rate at which an appliance brings a specified food product to a specified "cooked" condition.

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.

Recovery Time (minute, second)

The average time from the removal of the cooked food product from the griddle until the cooking surface is within 25°F of the thermostat set point and the fryer 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.

Typical Day

A sampled day of average appliance usage based on observations and/or operator interviews, used to develop an energy cost model for the appliance.

B Appliance Specifications

Appendix B includes the product literature for the Garland CG-36R griddle.

Appliance Specifications

GARLAND®
A *WELBILT* Company

Item # _____

Model # CG - ___R
Available in 24", 36", 48", 60", and 72" Widths. Specify.
Example: CG - 36R (Rear Grease)
Product Name: Master Griddle
Gas Type: ☐ Natural ☐ Propane

MODEL # CG - 48R
SHOWN WITH OPTIONAL STAND AND CASTERS

STANDARD FEATURES

- Rear Grease Trough c/w Front Rail
- 1" (25mm) Polished Finish Steel Plate
- One "U" Shaped 30,000 BTU (8.8 kw) Burner Every 12" (305mm) of Griddle Width
- Controls 120 volt, 60 Hz
- Electric Main On/Off Power Switch c/w Indicator Light
- Electronic On/Off Switch for Each Thermostat Burner System c/w Indicator Light
- Electronic Thermostat 150°F (101°C) to 450°F (268°C) for Each Burner Every 12" (305mm)
- Indicator Light to Indicate Gas Pilot Ignition
- Electronic Ignition
- Stainless Steel Sides
- Stainless Steel Valve Panel
- Stainless Steel Backguard
- Stainless Steel Grease Trough
- Stainless Steel Side Griddle Splashguards
- Stainless Steel Deep, Sloped Grease Drawers c/w Integral Grease Baffle
- 6" (152mm) High Stainless Steel Adjustable Legs
- Nickel Plated Thermostat Guards
- Gas Pressure Regulator
- 8" High Back Splash
- Contoured Grease Chute Opening

OPTIONAL FEATURES (No Additional Charge)

- 220 - 240 Volts, 50 Hz Supply

OPTIONAL FEATURES (Additional Charge)

- Stainless Steel Open Stand c/w Stainless Steel Bottom Shelf on Adjustable Legs
- Set of (4) Casters, All Swivel, Front Locking, for Stand

SPECIFICATIONS
GENERAL

Heavy duty gas griddles (available in five sizes, 24", 36", 48", 60" and 72"). High performance, volume production with even, consistant, controlled temperatures. 1" thick griddle plate. Electronic thermostat with imbedded sensor and efficient 'U' shaped burner every 12" of griddle width. All stainless steel exterior. Full width front rail. High capacity, sloped bottom, grease drawers. 6" legs standard or optional stand available.

Appliance Specifications

Appliance Specifications.

Manufacturer	Garland
Model	CG 36R
Generic Appliance Type	Electronically Controlled Thermostatic Griddle
Rated Input	90,000 Btu
Dimensions	36” x 39” x 19”
Construction	1”-thick stainless steel
Controls	Electronic thermostats temperature control adjustable from 150 to 450°F with ignition indicator lights.

C Results Reporting Sheets

Manufacturer: Garland
Model: CG-36R 01
Date: November 2001

Section 11.1 Test Griddle

Description of operational characteristics: 1-inch Polished finish steel plate with imbedded thermostat sensors. Three electronic thermostats control three 30,000 Btu/h burners U- shaped. The griddle comes with electronic ignition to light the pilots. Stainless steel construction on the splash guards, grease, trough and front panel.

Section 11.2 Apparatus

√ Check if testing apparatus conformed to specifications in section 6.

Deviations: None.

Section 11.4 Energy Input Rate

Heating Value	90,000 Btu/h
Measured	85,980 Btu/h
Percent Difference between Measured and Rated	4.47 %

Section 11.5 Temperature Uniformity and Thermostat Accuracy

Thermostat settings required to maintain 375°F cooking surface temperature:

Thermostat #1	380 °F
Thermostat #2	378 °F
Thermostat #3	382 °F
Maximum Temperature Difference	34 °F

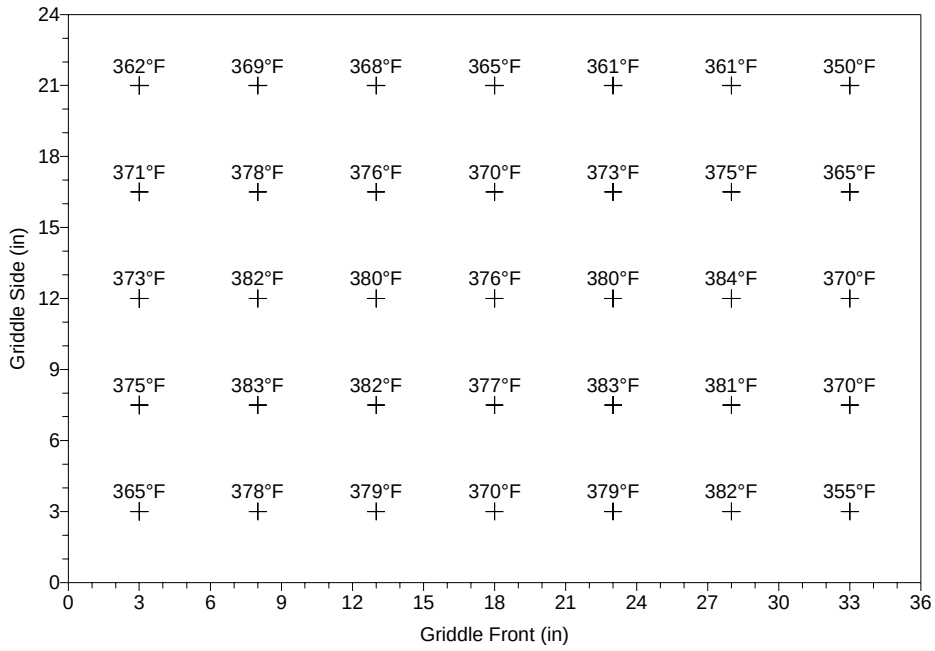

Figure C-1. Average cooking surface temperatures.

Section 11.6 Preheat Energy and Time

Heating Value	1013.6 Btu/scf
Starting Temperature	74 °F
Energy Consumption	18,780 Btu
Duration	13.27 min
Preheat Rate	22.8 °F/min

Results Reporting Sheets

Section 11.7 Idle Energy Rate

Heating Value	1013.1 Btu/scf
Idle Energy Rate @ 375°F	17,465 Btu/h

Section 11.9 Cooking Energy Efficiency and Cooking Energy Rate

Extra-Heavy Load:

Heating Value	1013.2 Btu/scf
Cooking Time	7.0 min
Average Cooking Surface Recovery Time	1.0 min
Production Capacity	56.2 ± 0.1 lb/h
Energy to Food	488 Btu/lb
Cooking Energy Rate	61,051 Btu/h
Energy per Pound of Food Cooked	1,086 Btu/lb
Cooking Energy Efficiency	44.9 ± 0.1 %

Heavy Load:

Heating Value	1014.2 Btu/scf
Cooking Time	6.8 min
Average Cooking Surface Recovery Time	< 1 min
Production Capacity	46.2 ± 1.0 lb/h
Energy to Food	486 Btu/lb
Cooking Energy Rate	54,842 Btu/h
Energy per Pound of Food Cooked	1,188 Btu/lb
Cooking Energy Efficiency	40.9 ± 0.1 %

Medium Load:

Heating Value	1014.2 Btu/scf
Cooking Time	7.7 min
Average Cooking Surface Recovery Time	39.0 min
Production Capacity	21.6 ± 0.2 lb/h
Energy to Food	487 Btu/lb
Cooking Energy Rate	35,008 Btu/h
Energy per Pound of Food Cooked	1,619 Btu/lb
Cooking Energy Efficiency	30.1 ± 1.2 %

Results Reporting Sheets

Light Load:

Heating Value	1024.1 Btu/scf
Cooking Time	7.83 min
Average Cooking Surface Recovery Time	41.4 sec
Production Capacity	14.1 ± 0.4 lb/h
Energy to Food	480 Btu/lb
Cooking Energy Rate	47,438 Btu/h
Energy per Pound of Food Cooked	3,324 Btu/lb
Cooking Energy Efficiency	14.3 ± 1.4 %

D Cooking Energy Efficiency Data

Table D-1. Specific Heat and Latent Heat.

Specific Heat (Btu/lb, °F)	
Ice	0.50
Fat	0.40
Solids	0.20
Latent Heat (Btu/lb)	
Fusion, Water	144
Fusion, Fat	44
Vaporization, Water	970

Cooking Energy Efficiency Data

Table D-2. Heavy-Load Test Data.

	Repetition #1	Repetition #2	Repetition #3
Measured Values			
Total Energy (Btu)	43,509	42,893	42,2611
Cook Time (min)	**6.87**	**6.83**	**6.83**
Total Test Time (min)	47.3	46.9	46.5
Weight Loss (%)	34.7	34.6	34.1
Initial Weight (lb)	36.115	36.115	36.115
Final Weight (lb)	23.600	23.611	23.795
Initial Fat Content (%)	17.9	17.9	17.9
Initial Moisture Content (%)	62.1	62.1	62.1
Final Moisture Content (%)	50.1	51.2	51.8
Initial Temperature (°F)	0	0	0
Final Temperature (°F)	162	162	161
Calculated Values			
Initial Weight of Water (lb)	22.423	22.423	22.423
Final Weight of Water (lb)	11.833	12.079	12.334
Weight of Fat (lb)	6.469	6.469	6.469
Weight of Solids (lb)	7.223	7.223	7.223
Sensible to Ice (Btu)	359	359	359
Sensible to Water (Btu)	2,913	2,911	2,881
Sensible to Fat (Btu)	419	419	415
Sensible to Solids (Btu)	234	234	232
Latent - Water Fusion (Btu)	3,229	3,229	3,229
Latent - Fat Fusion (Btu)	286	286	286
Latent - Water Vaporization (Btu)	10,272	10,034	9,786
Total Energy to Food (Btu)	17,712	17,471	17,189
Energy to Food (Btu/lb)	**490**	**484**	**476**
Total Energy to Griddle	43,509	42,893	42,261
Energy to Griddle (Btu/lb)	**1,205**	**1,188**	**1,170**
Cooking Energy Efficiency (%)	**40.7**	**40.7**	**40.7**
Cooking Energy Rate (Btu/h)	**55,180**	**54,827**	**54,518**
Production Rate (lb/h)	**45.8**	**46.2**	**46.6**
Average Recovery Time (min)	**< 1.0**	**< 1.0**	**< 1.0**

Cooking Energy Efficiency Data

Table D-3. Extra-Heavy Load Test Data.

	Repetition #1	Repetition #2	Repetition #3
Measured Values			
Total Energy (Btu)	48,286	50,028	48,829
Cook Time (min)	**6.98**	**7.04**	**6.99**
Total Test Time (min)	48.2	48.2	48.3
Weight Loss (%)	33.6	36.6	34.3
Initial Weight (lb)	45.144	45.144	45.144
Final Weight (lb)	29.595	28.631	29.644
Initial Fat Content (%)	17.9	17.9	17.9
Initial Moisture Content (%)	62.1	62.1	62.1
Final Moisture Content (%)	50.1	51.2	51.8
Initial Temperature (°F)	0	0	0
Final Temperature (°F)	159	167	161
Calculated Values			
Initial Weight of Water (lb)	28.029	28.029	28.029
Final Weight of Water (lb)	15.021	14.647	15.366
Weight of Fat (lb)	8.086	8.086	8.086
Weight of Solids (lb)	9.029	9.029	9.029
Sensible to Ice (Btu)	448	448	448
Sensible to Water (Btu)	3,567	3,781	3,618
Sensible to Fat (Btu)	515	540	521
Sensible to Solids (Btu)	288	301	291
Latent - Water Fusion (Btu)	4,036	4,036	4,036
Latent - Fat Fusion (Btu)	358	354	357
Latent - Water Vaporization (Btu)	12,617	12,981	12,283
Total Energy to Food (Btu)	21,830	22,442	21,555
Energy to Food (Btu/lb)	**484**	**497**	**477**
Total Energy to Griddle	48,286	50,028	48,829
Energy to Griddle (Btu/lb)	**1,070**	**1,108**	**1,082**
Cooking Energy Efficiency (%)	**45.2**	**44.9**	**44.1**
Cooking Energy Rate (Btu/h)	**60,107**	**62,328**	**60,720**
Production Rate (lb/h)	**56.2**	**56.2**	**56.1**
Average Recovery Time (min)	**1.1**	**1.0**	**1.0**

Cooking Energy Efficiency Data

Table D-4. Medium-Load Test Data.

	Repetition #1	Repetition #2	Repetition #3
Measured Values			
Appliance Gas (Btu)	29,233	29,317	29,178
Cook Time (min)	**7.72**	**7.66**	**7.73**
Total Test Time (min)	49.9	50.2	50.3
Weight Loss (%)	35.1	35.1	33.9
Initial Weight (lb)	18.058	18.058	18.058
Final Weight (lb)	11.712	11.717	11.940
Initial Fat Content (%)	17.9	17.9	17.9
Initial Moisture Content (%)	62.1	62.1	62.1
Final Moisture Content (%)	50.1	51.2	51.8
Initial Temperature (°F)	0	0	0
Final Temperature (°F)	163	163	160
Calculated Values			
Initial Weight of Water (lb)	11.211	11.211	11.211
Final Weight of Water (lb)	5.872	5.994	6.189
Weight of Fat (lb)	3.235	3.235	3.235
Weight of Solids (lb)	3.612	3.612	3.612
Sensible to Ice (Btu)	179	179	179
Sensible to Water (Btu)	1,471	1,470	1,434
Sensible to Fat (Btu)	211	211	211
Sensible to Solids (Btu)	118	118	118
Latent - Water Fusion (Btu)	1,614	1,614	1,614
Latent - Fat Fusion (Btu)	142	142	142
Latent - Water Vaporization (Btu)	5,719	5,061	4,872
Total Energy to Food (Btu)	8,915	8,796	8,565
Energy to Food (Btu/lb)	**494**	**487**	**474**
Total Energy to Griddle	29,233	29,317	29,178
Energy to Griddle (Btu/lb)	**1,619**	**1,624**	**1,616**
Cooking Energy Efficiency (%)	**30.5**	**30.0**	**29.4**
Cooking Energy Rate (Btu/h)	**35,164**	**35,033**	**34,826**
Production Rate (lb/h)	**21.7**	**21.6**	**21.6**
Average Recovery Time (min)	**0.6**	**0.7**	**0.7**

Cooking Energy Efficiency Data

Table D-5. Light-Load Test Data.

	Repetition #1	Repetition #2	Repetition #3
Measured Values			
Total Energy (Btu/h)	22,665	23,694	22,919
Cook Time (min)	**8.95**	**9.60**	**9.27**
Total Test Time (min)	56.4	60.4	58.2
Weight Loss (%)	33.9%	35.2%	34.1%
Initial Weight (lb)	6.019	6.019	6.019
Final Weight (lb)	3.979	3.900	3.966
Initial Fat Content (%)	17.9%	17.9%	17.9%
Initial Moisture Content (%)	62.1%	62.1%	62.1%
Final Moisture Content (%)	50.1%	51.2%	51.8%
Initial Temperature (°F)	0	0	0
Final Temperature (°F)	160	163	161
Calculated Values			
Initial Weight of Water (lb)	3.737	3.737	3.737
Final Weight of Water (lb)	1.995	1.995	2.055
Weight of Fat (lb)	1.078	1.078	1.078
Weight of Solids (lb)	1.204	1.204	1.204
Sensible to Ice (Btu)	60	60	60
Sensible to Water (Btu)	478	491	480
Sensible to Fat (Btu)	69	70	69
Sensible to Solids (Btu)	39	39	39
Latent - Water Fusion (Btu)	538	538	538
Latent - Fat Fusion (Btu)	48	47	48
Latent - Water Vaporization (Btu)	1,690	1,690	1,631
Total Energy to Food (Btu)	2,921	2,936	2,865
Energy to Food (Btu/lb)	**485**	**488**	**476**
Total Energy to Griddle	22,665	23,694	22,919
Energy to Griddle (Btu/lb)	**3,766**	**3,936**	**3,808**
Cooking Energy Efficiency (%)	**12.9**	**12.4**	**12.5**
Cooking Energy Rate (Btu/h)	**24,121**	**23,537**	**23,632**
Production Rate (lb/h)	**6.4**	**6.0**	**6.2**
Average Recovery Time (min)	**0.45**	**0.46**	**0.43**

Cooking Energy Efficiency Data

Table D-6. Cooking Energy Efficiency and Production Capacity Statistics.

	Cooking Energy Efficiency				Production Capacity [a]
	Extra-Heavy Load	Heavy Load	Medium Load	Light Load	
Replicate #1	45.2	40.7	30.5	12.9	45.8
Replicate #2	44.9	40.7	30.0	12.4	46.2
Replicate #3	44.1	40.7	29.4	12.5	46.6
Average	**44.7**	**40.7**	**30.0**	**12.6**	**46.2**
Standard Deviation	0.54	0.03	0.57	0.26	0.39
Absolute Uncertainty	1.35	0.10	1.42	0.65	0.98
Percent Uncertainty	3.01	0.20	4.74	5.15	2.12

[a] Based on the heavy-load cooking test with a minimum 30-second preparation time between loads.