Food Service
Technology Center

Baxter Model OV500G2-EE Double Rack Oven Test Report

FSTC Report # 501311072-R1

Application of ASTM
Standard Test Method F2093-11

January 2012

Prepared by:
Michael Karsz
David Zabrowski
Fisher-Nickel, Inc.

Prepared for:
Pacific Gas & Electric Company
Customer Energy Efficiency Programs
PO Box 770000
San Francisco, California 94177

Food Service Technology Center Background

The information in this report is based on data generated at the PG&E Food Service Technology Center (FSTC). Dedicated to the advancement of the foodservice industry, The FSTC has focused on the development of standard test methods for commercial foodservice equipment since 1987. The primary component of the FSTC is a 10,000 square-foot appliance laboratory equipped with energy monitoring and data acquisition hardware, 60 linear feet of canopy exhaust hoods integrated with utility distribution systems, appliance setup and storage areas, and a state-of-the-art demonstration and training facility.

The FSTC Energy Efficiency for Foodservice Program is funded by California utility customers and administered by Pacific Gas & Electric Company (PG&E) under the auspices of the California Public Utilities Commission. California consumers are not obligated to purchase any full service or other service not funded by the program.

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

- Fisher-Nickel, Inc. and the FSTC do not endorse particular products or services from any specific manufacturer or service provider.
- The FSTC is *strongly* committed to testing foodservice 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 FSTC. 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.

Disclaimer

Neither Fisher-Nickel, Inc. nor the FSTC 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 FSTC or PG&E. In no event will Fisher-Nickel, Inc. or PG&E be liable for any special, incidental, consequential, indirect, or similar damages, including but not limited to lost profits, lost market share, lost savings, lost data, increased cost of production, or any other damages arising out of the use of the data or the interpretation of the data presented in this report.

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.

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.

Revision History

Revision num.	Date	Description	Author(s)
0	December 2011	Initial release	Michael Karsz / David Zabrowski
1	January 2012	Updated appliance specifications (Appendix C)	Michael Karsz

Contents

Figures

Tables

Executive Summary

Many foodservice operations, such as cafeterias and grocery stores, require high volume baking of diverse, uniform, and quality food product in the convenience of a single appliance. Roll-in rotating rack ovens offer the cavity capacity necessary to evenly bake large quantities of bread, pie, cake, and various pastries with a relatively small footprint. Most rack ovens also feature a steam generator for baking crusty breads. Additionally, rack ovens have the ability to roast various cuts of meat and re-thermalize food products that were previously chilled. A double rack oven is capable of baking 30 pans of food product at one time, effectively replacing six full-size convection ovens. Operation versatility coupled with a space-saving compactness make rack ovens ideal for most large scale foodservice operations.

The Baxter OV500G2-EE oven (Figure 1) is a 30-pan capacity, gas-fired double rack oven utilizing a self-contained spherical cast steam system, an auto rack lift, and a 275,000 Btu/h in-shot burner. To determine the performance of the Baxter OV500G2-EE, FSTC engineers used Standard F2093-11, *Standard Test Method for Performance of Rack Ovens*[1]. Oven performance was characterized by preheat duration and energy consumption, idle energy consumption rate, steam performance, baking energy rate and efficiency, production capacity, and browning uniformity. Steam performance was measured by monitoring the oven's steam generation over the course of five consecutive steam cycles. The results of the 10-second steam performance test are presented in Figure 2. Baking energy efficiency and production capacity were determined using frozen apple pies. Browning uniformity was observed using white sheet cakes. The Baxter Double Rack Oven achieved a baking energy efficiency of 55.1% while producing 277.0 pounds of baked apple pies per hour. A summary of the test results is presented in Table 1.

Figure 1: Baxter OV500G2-EE Double Rack Oven

[1] American Society for Testing and Materials. 2011. *Standard Test Method for Performance of Rack Ovens.* ASTM Designation F2093-11, in *Annual Book of ASTM Standards,* West Conshohocken, PA.

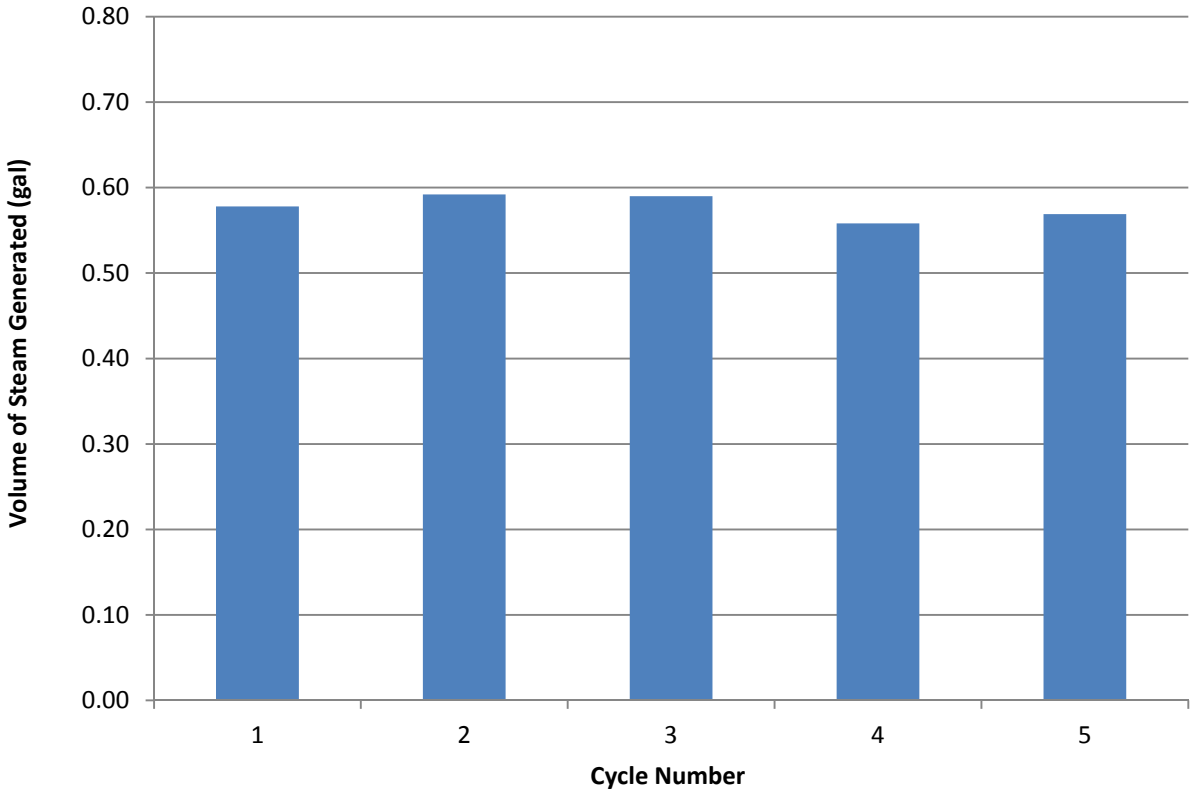


Figure 2: Baxter OV500G2-EE Steam Performance (10 Seconds)

Table 1: Summary of Baxter OV500G2-EE Double Rack Oven Performance

Rated Energy Input Rate (Btu/h)	275,000
Measured Energy Input Rate (Btu/h)	272,056
Preheat to 390°F:	
Preheat Time (min)	12.56
Preheat Energy (Btu)	53,452
Gas Idle Energy Rate at 400°F (Btu/h)	26,016
Electric Idle Fan/Control Idle Energy Rate (kW)	1.01
Setback/Energy-Saving Mode Idle Energy Rate at 250°F (Btu/h)	9,422
Baking Energy Efficiency (%)	55.1 ± 1.5
Production Capacity (lb/h)	277.0 ± 4.2

Introduction

Background

The test methods in this report were approved and ratified by the American Society for Testing and Materials (ASTM) in designation F2093-11. These test methods allow for benchmarking of equipment in a way that users can make meaningful comparisons between appliances.

ASTM appliance performance standards can be used to estimate an appliance's contribution to the energy consumption of an end-user's kitchen. The ASTM designation F2093-11 test method characterizes rack oven baking performance.

Objectives

The objective of this report is to examine the operation and performance of the Baxter OV500G2-EE under the controlled conditions of the ASTM designation F2093-11, Standard Test Method for Performance of Rack Ovens. The scope of this testing is as follows:

1. Verify that the appliance is operating at the manufacturer's rated energy input. Calibrate appliance thermostat to specified operating temperature if necessary.
2. Determine the time and energy required to preheat the appliance from room temperature to operating conditions.
3. Determine the idle energy rate with the rack oven set to maintain 400°F in the baking chamber.
4. Characterize the rack oven's ability to produce steam during successive baking cycles.
5. Characterize the oven's browning uniformity by baking white sheet cakes.
6. Document the baking energy consumption and baking energy efficiency using frozen apple pies as test product.
7. Determine the baking time and production capacity.
8. Estimate the annual operating cost for operating the rack oven using a standard cost model.

Appliance Description

The Baxter OV500G2-EE (see Figure 1) is a roll-in double rack, 30-sheet pan capacity, natural gas-fired oven featuring a 275,000 Btu/h in-shot burner with a heat exchanger consisting of 18 independent high temperature stainless steel tubes. The oven requires two electric power supplies: (1) a 120 V single-phase 15 A connection and (2) a 240 V 3-phase 4.4 A connection. The Baxter comes equipped with an integrated eyebrow ventilation hood, overhead auto rack lift/rotator device, and a ½" water connection. Waste water is exited through a ⅜" drain located at the bottom-right on the front face of the oven. On the left side of the oven door, the oven fea-

tures a digital control panel with 99 programmable menus along with four-stage baking, auto on/off, auto set-back, and auto vent settings. Hot air is delivered to the food product through a ceiling-mounted axial fan that pulls air up from the heating element and evenly distributes it around the baking chamber. Appliance specifications are listed in Table 2 and the manufacturer's literature is provided in Appendix C.

Table 2: Appliance Specifications

Manufacturer	Baxter Manufacturing
Model	OV500G2-EE
Serial Number	24-2005520
Generic Appliance Type	Double rack gas oven
Rated Input	275,000 Btu/h
Construction	Stainless steel
Controls	Programmable digital control
Compartment Capacity (as tested)	30 full-size (18" x 26") sheet pans
External Dimensions (W x D x H)	72" x 62" x 104"
Hood Overhang	33.5"

Methods and Results

Setup and Instrumentation

The Baxter OV500G2-EE Double Rack Oven was installed in accordance with the manufacturer's instructions and Section 9 of the ASTM test method in a conditioned test space. The room was maintained at an ambient condition of 75 ± 5°F during testing. Inlet gas volume was measured with a positive-displacement meter. Inlet gas pressure was also measured. Two watt-hour transducers measured fan motor and control electric energy to the oven. Water usage was measured with an in-line flow sensor installed on the water inlet hose. To monitor oven cavity temperature, 24-gauge Type-K Teflon-insulated thermocouple wire was mounted at the vertical center of the oven's pressure panel in the air outlet. Type-K thermocouples were also used to monitor ambient, gas, air panel, and apple pie temperature. The gas meter, transducers, water meter, and thermocouple probes were connected to a computerized data acquisition unit that recorded data every 5 seconds.

Table 3: Testing Equipment Inventory

Description	Manufacturer	Model	Measurement Range	Resolution
Gas meter	Sensus	415	0 CFH – 415 CFH[a]	0.05 ft^3
Electric meter[b]	Shark	200	0.2 A – 50.0 A	7.5 Wh
Electric meter[c]	Radian Research	Metronic RM-10	0.005 A – 11.0 A	0.00001Wh
Water meter	Omega	FTB4705	0.2 gpm – 18 gpm	0.002 gal
Pit scale	Mettler-Toledo	ID1 Plus	0 lb – 600 lb	0.05 lb
Table scale	Sartorius Group	Acculab SCI20B	0 kg – 20 kg	2.0 g
Thermometer	Fluke	50 Series II	-328°F – 2502°F	0.1°F

[a] Based on 0.6 specific gravity gas measured at 4 oz base pressure and 60°F at ½" wc differential pressure.

[b] Measured electric energy to the fan motor.

[c] Measured electric energy to the control panel.

Measured Energy Input Rate Test and Thermostat Calibration

Rated energy input rate is the maximum or peak rate at which the oven consumes energy, as specified on the oven's nameplate. Measured energy input rate is the maximum or peak rate of energy consumption, which is recorded during a period when the burners are fully energized (such as preheat). Prior to testing, the energy input rate was determined by measuring the energy consumed from the time the oven first began operating until the burners first cycled off. This procedure ensured that the oven was operating at a measured energy input rate that was within ± 5% of its rated energy input rate. The measured energy input rate of the Baxter OV500G2-EE Double Rack Oven was 272,056 Btu/h (a difference of 1.1% from the nameplate rating). Table 4 summarizes the results from the input test.

Table 4: Input Rate Test Results

Rated Energy Input Rate (Btu/h)	275,000
Measured Energy Input Rate (Btu/h)	272,056
Percentage Difference (%)	1.1

Thermostat calibration was verified by allowing the oven to operate with the thermostat set to the specified operating temperature of 400°F for a stabilization period of two hours. The cavity temperature was then monitored and recorded every 30 seconds for a period of one hour. If the average cavity temperature was more than 405°F or less than 395°F, the controls were adjusted, the oven was allowed to re-stabilize for 1 hour, and the cavity temperature was again monitored for one hour. This process was repeated until an average oven temperature of 400 ± 5°F was reached. With the thermostat set to an indicated 400°F on the Baxter

OV500G2-EE, the oven temperature at the pressure panel averaged 397.9°F. Therefore, testing was conducted with the thermostat at an indicated 400°F for all tests with the exception of the browning uniformity sheet cake test, which was conducted at an indicated temperature of 325°F.

Preheat and Idle Tests

The results of the preheat and idle tests were based on the average of three test replicates.

Preheat Test

All preheat tests were conducted at the beginning of a test day after the oven cavity had been stabilized to room temperature overnight. Recording began when the oven was first turned on, so any time delay before the powering of the burners after the oven was turned on was included in the test. The rack oven preheat test recorded the time and energy required for the oven to increase the cavity temperature from 75 ± 5°F to a temperature of 390°F. During the preheat test, the oven reached a ready-to-bake state in 12.56 minutes while consuming 53,452 Btu. Figure 3 shows the preheat curve for the double rack oven.

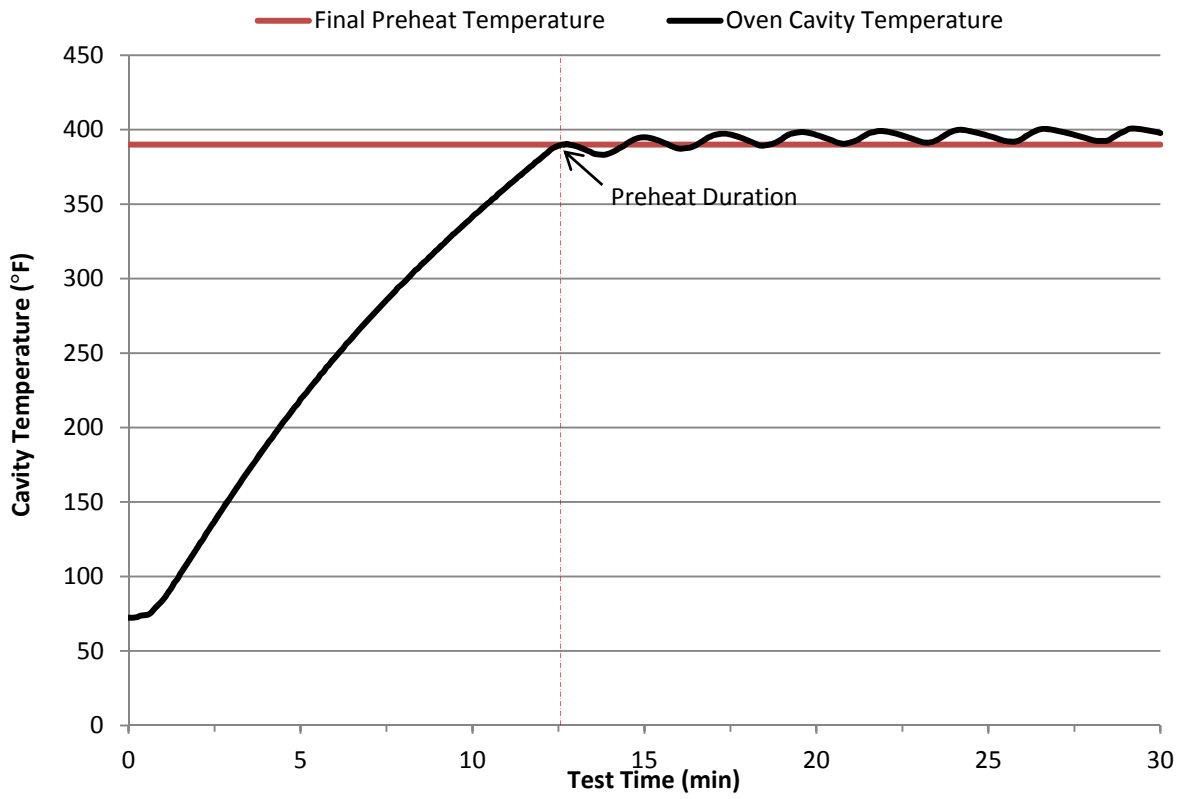


Figure 3: Preheat Characteristics

Idle Test

After the oven preheated, it was allowed to stabilize for two hours before beginning the idle tests. Idle energy rate represents the energy required to maintain the set-point temperature for a period of at least three hours. During this period, time and energy consumption were monitored while the oven maintained an operational temperature of 400 ± 5°F. The idle energy rate while maintaining a ready-to-bake state was 26,016 Btu/h. Table 5 summarizes the results from the preheat and idle tests.

Table 5: Preheat and Idle Test Results

Preheat to Operational Temperature:	
Final Preheat Temperature (°F)	390.4
Duration (min)	12.56
Gas Energy Consumption (Btu)	53,452
Electric Energy Consumption (kWh)	0.27
Idle:	
Average Cavity Temperature (°F)	397.9
Gas Energy Rate (Btu/h)	26,016
Electric Energy Rate (kW)	1.01

Setback/Energy-Saving Mode Idle and Recovery Tests

Many rack ovens employ a setback or energy-saving mode to help conserve energy when idling and shorten the time it takes the oven to reach baking operating temperature. When the Baxter OV500G2-EE idles at 400°F for 90 minutes[2], the setback mode is automatically initiated and the oven decreases its set temperature to 250°F. Since the ASTM standard test method F2093-11 does not include any performance tests for rack ovens in this particular energy-saving mode, the manufacturer requested that the FSTC test the oven's energy consumption when idling in setback mode at 250 ± 5°F and to test the duration and energy consumption when the oven recovered from 250°F to 390°F. After the oven was allowed to stabilize in setback mode for a minimum of two hours, researchers monitored oven energy consumption for an additional three hours for the idle test. While maintaining an average cavity temperature of 250 ± 5°F, the setback idle rate was 9,422 Btu/h. For the recovery test, the oven set temperature was then increased back to 400°F. Elapsed time and energy consumption were monitored until the oven reached 390°F from the initial setback temperature of 250 ± 5°F. The oven reached a ready-to-bake state from setback mode in 5.00 minutes while consuming 21,586 Btu. The results of the setback/energy-saving mode tests are summarized in Table 6.

[2]This is a factory setting time that can be changed on installation.

Table 6: Setback/Energy-Saving Mode Test Results

Setback Idle:	
Average Cavity Temperature (°F)	252.6
Gas Energy Rate (Btu/h)	9,422
Electric Energy Rate (kW)	1.15
Recovery to 390°F:	
Duration (min)	5.00
Energy Consumption (Btu)	21,586

Steam Performance Test

The steam performance test was conducted to evaluate the steam generation of the double rack oven on repeated bake cycles. The double rack oven was stabilized at 400 ± 5°F for a minimum of two hours before the steam test. The test consisted of five successive baking cycles performed at 15-minute intervals. As per the manufacturer's request, the steam test was performed twice with steam injection times set for 10 seconds and 15 seconds. Water consumption and water runoff were measured and documented for each cycle. Steam generation was determined as the difference between the volume of water running into the oven and the volume of runoff water collected from the drain. Table 7, Table 8, and Figure 4 summarize the results of the steam performance tests.

Table 7: Steam Performance Test Results (10 Seconds)

Cycle Number	1	2	3	4	5
Water Injection Time (sec)	10	10	10	10	10
Volume of Water Consumed (gal)	0.58	0.59	0.59	0.56	0.57
Volume of Runoff (gal)	0.00	0.00	0.00	0.00	0.00
Volume of Steam Generated (gal)	0.58	0.59	0.59	0.56	0.57

Table 8: Steam Performance Test Results (15 Seconds)

Cycle Number	1	2	3	4	5
Water Injection Time (sec)	15	15	15	15	15
Volume of Water Consumed (gal)	0.83	0.84	0.84	0.84	0.82
Volume of Runoff (gal)	0.00	0.00	0.00	0.00	0.00
Volume of Steam Generated (gal)	0.83	0.84	0.84	0.84	0.82

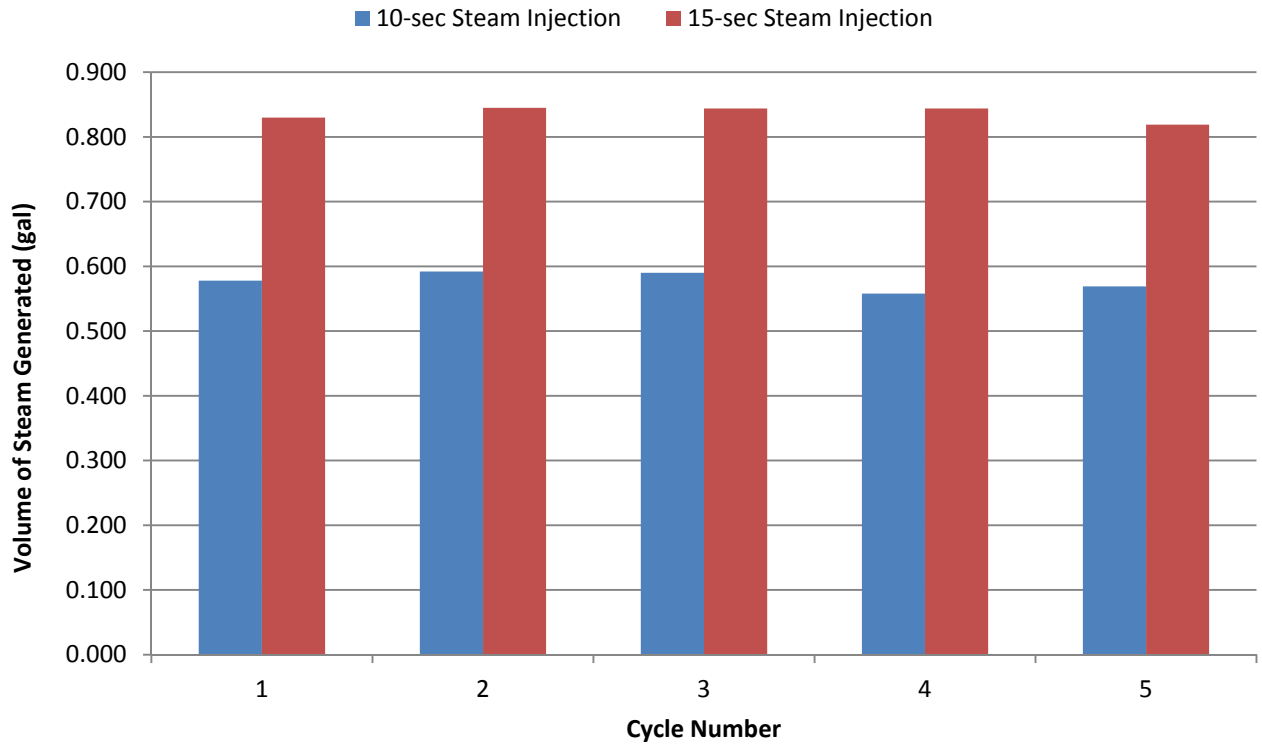


Figure 4: Steam Production and Repeatability (10- and 15- Second Steam Injection Time)

Baking Tests

Pie Tests

A total of three baking-efficiency test replicates were performed on the Baxter OV500G2-EE. The uncertainty of the energy efficiency and production capacity calculated for each baking test run was less than the ±10% required by the standard, as per ASTM standard F2093-11.

For each baking energy efficiency test, the oven was stabilized for a minimum of two hours at 400°F. Ten-inch ready-to-bake frozen apple pies consisting of pre-cooked apple based filling were placed on parchment paper-lined full-size sheet pans for baking. Figure 5 shows a cross-section of a sample apple pie used in the baking energy efficiency test.

Figure 5: Cross Section of a Frozen Apple Pie

Three pies were placed on each sheet pan for a total of 90 pies per test run. Pies were loaded from a walk-in freezer into the double rack with haste to prevent any increase in frozen pie temperature. Thirty randomly selected pies were prodded with a thermometer prior to baking to confirm an initial average temperature of 0 ± 5°F. The rack, pies, and pans were weighed on a pit scale before and after the baking test. For bake time determination on the first test run, four randomly selected pies were probed with heavy-duty chef thermometers in a position where the dial was visible from the oven window. Figure 6 shows one such probed pie. The double rack was then loaded into the oven within 45 ± 5 seconds and baking commenced. Once the oven door was shut, bake time, oven temperature, and energy consumption were monitored.

Figure 6: Probed Pie for Bake Time Determination

As soon as the four probed pies displayed an average internal temperature of 180°F, the pie rack was promptly removed from the oven. Within three minutes of their removal from the rack oven, baked pie temperatures were measured using a rig that held three fixed thermocouples in a straight line across the diameter of the pie so that the sensing point could be easily located in the middle of the filling. The thermocouple rig is shown in Figure 7. One randomly-selected pie from each pan was probed with the thermocouple rig to show an average internal temperature of 185 ± 5°F.

Figure 7: Thermocouple Rig for Measuring Baked Pie Temperature

Energy imparted to the frozen apple pies is the sum of the energy required to raise their temperatures from 0 ± 5°F to 185 ± 5°F (sensible energy), the energy required to melt the frozen water in the apple pies (fusion energy), and the energy required to vaporize a portion of the water contained in the pies (vaporization energy). Baking energy efficiency is the quantity of energy consumed by the frozen pies and pans expressed as a percentage of energy consumed by the rack oven during the pie baking test. Baking energy efficiency is therefore represented by the following equation:

$$\text{Baking Energy Efficiency} = \frac{\text{Energy to Pies and Pans}}{\text{Energy to Oven}}$$

The apple pie test procedure demonstrated an average baking energy efficiency of 55.1% with a production capacity of 277.0 lb of baked apple pies per hour. Table 9 summarizes the results from the baking energy efficiency and production capacity tests. Appendix D contains a synopsis of the test data for each replicate of the pie tests.

Table 9: Baking Energy Efficiency and Production Capacity Test Results

Food Product	Apple Pie
Pies per Load	90
Bake Time (min)	56.70
Baking Energy Rate (Btu/h)	112,960
Energy to Food (Btu/lb)	218
Energy to Rack Oven (Btu/lb)	421
Baking Energy Efficiency (%)	55.1 ± 1.5
Production Capacity (lb/h)	277.0 ± 4.2

Browning Uniformity Test (White Sheet Cakes)

A browning uniformity test was performed on the Baxter OV500G2-EE Double Rack Oven. This test provides a visual representation of the oven's temperature uniformity while baking. Browning uniformity is evaluated by baking white sheet cakes. The rack oven was allowed to stabilize at 325°F for a minimum of two hours. Thirty full-size sheet pans were each filled with five pounds of cake batter and loaded into the oven. The cakes were determined to be fully baked when inserting and removing a wooden skewer into the center of the cakes left no moist cake particles on the skewer. The sheet cake bake time was determined to be 34.02 minutes for the Baxter OV500G2-EE. Once the cakes were removed from the oven, photographs were taken of each sheet cake, and the rack position of each pan noted. The top and bottom positions exhibited the most browning, while the middle racks were the lightest in color. The photographic results from the browning uniformity test are presented in Figure 8.

Pan 1 – Top Rack Position

Pan 16 – Top Rack Position

Pan 7 – Middle Rack Position

Pan 22 – Middle Rack Position

Pan 15 – Bottom Rack Position

Pan 30 – Bottom Rack Position

Figure 8: Sheet Cake Uniformity Results

Energy Cost Model

The test results can be used to estimate the annual energy consumption for the double rack oven in a real-world operation. A simple cost model was developed to calculate the relationship between the various cost components (e.g., preheat, idle and baking costs) and the annual operating cost using the ASTM test data. The cost model incorporates the setback mode during idle periods, which is the normal operating state for this double rack oven. Table 10 shows the assumptions for the oven's daily operation:

Table 10: Daily Oven Operation Assumptions

Operating Time per Day (h)	12
Operating Time in Setback Mode per Day (h)	3
Operating Days per Year (d)	365
Number of Preheats per Day	1
Total Amount of Food Baked per Day (lb)	1,200

Based on the assumptions above, total daily energy consumption was determined by adding the daily preheat energy consumed, the daily idle and setback energy consumed, and the daily baking energy consumed.

$$E_{daily,\,total} = E_{daily,\,gas} + E_{daily,\,elec}$$

$$E_{daily,\,gas} = E_{h,\,gas} + E_{i,\,gas} + E_{s,\,gas} + n_p \times E_{p,\,gas} \qquad E_{daily,\,elec} = E_{h,\,elec} + E_{i,\,elec} + E_{s,\,elec} + n_p \times E_{p,\,elec}$$

Where:

$E_{daily,total}$	=	Total daily energy consumption			
$E_{daily,gas}$	=	Daily gas energy consumption	$E_{daily,elec}$	=	Daily electric energy consumption
$E_{h,gas}$	=	Daily gas energy imparted to food	$E_{h,elec}$	=	Daily electric energy imparted to food
$E_{i,gas}$	=	Daily gas energy consumed during idle	$E_{i,elec}$	=	Daily electric energy consumed during idle
$E_{s,gas}$	=	Daily gas energy consumed during setback	$E_{s,elec}$	=	Daily electric energy consumed during setback
$E_{p,gas}$	=	Daily gas energy consumed during preheat	$E_{p,elec}$	=	Daily electric energy consumed during preheat
n_p	=	Number of preheats per day			

Assuming the Baxter OV500G2-EE Double Rack Oven baked 1,200 lb of food product over a 12-hour day, operated 365 days a year, operated in setback mode for 3 hours per day, and had one preheat per day, it is estimated that the oven would consume 2,508 therms of gas and 4,741 kWh of electricity annually. Using a rate of $1.00 per therm and $0.10 per kWh, the estimated operational cost of the Baxter OV500G2-EE Double Rack Oven is $2,982 per year. Table 11 summarizes the annual energy consumption and associated energy costs for the rack oven under this scenario.

Table 11: Estimated Double Rack Oven Energy Consumption and Cost

	Gas (Btu)	Electric (kWh)
Daily Preheat Energy	53,452	0.27
Daily Idle Energy	115,993	4.50
Daily Setback Energy	28,266	3.45
Daily Baking Energy	489,357	4.77
Annual Gas Consumption (therms/yr)[a]	2,508	–
Annual Electric Consumption (kWh/yr)	–	4,741
Total Annual Cost ($/year)[b]	$2,982	

[a] One therm = 100,000 Btu

[b] Oven energy costs are based on $1.00/therm and $0.10/kWh.

Additional Resources

1. American Society for Testing and Materials. 2011. *Standard Test Method for Performance of Rack Ovens.* ASTM Designation F2093-11, in *Annual Book of ASTM Standards,* West Conshohocken, PA.

2. Sorensen, G., Zabrowski, D., 2006. *Revent Model 724U Gas Double-Rack Oven.* Food Service Technology Center Report 5011.06.07, August.

3. Sorensen, G., Zabrowski, D., 2006. *Rational Model SCC 62G Gas Combination Oven.* Food Service Technology Center Report 5011.06.10, July.

4. Sorensen, G., Zabrowski, D., 2006. *Hobart Model HBA2G Gas Double-Rack Oven.* Food Service Technology Center Report 5011.06.14, June.

5. Karsz, M., Zabrowski, D., 2011. *Cleveland Convotherm Model OGS20.20 Combination Oven.* Food Service Technology Center Report 501310062, December.

Appendix A: Glossary of Terms

Baking Energy Rate (kW Btu/h, or kBtu/h)
The average rate of energy consumption during the baking period.

Baking Energy Efficiency (%)
The quantity of energy input to the food product; expressed as a percentage of the quantity of the energy input to the appliance during the baking test.

Energy to Food (Btu/lb)
Energy consumed by the food during the baking test per initial weight, in pounds, of food baked.

Energy to Oven (Btu/lb)
Energy consumed by the oven during the baking test per initial weight, in pounds, of food baked. Energy includes sum of all fuel types used (ie. energy for heating oven, plus electric energy used by oven controls, fans, and pilots).

Food Product
A type of product (eg. pies, cake) designated by a baking standard and prepared according to a test method which is used to determine an appliance's baking performance.

Heating Value (Btu/ft^3)
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)
The rate of appliance energy consumption while it is "holding" or maintaining a stabilized operating condition or temperature (measured while the oven cavity is empty).

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

Measured Input Rate (kW, Btu/h, or kBtu/h)
The peak rate at which an appliance will consume energy, typically measured during preheat (i.e. the period of operation when all burners or elements are "on"). Does not include energy used for appliance controls, fans, or pilots.

Preheat Energy (kWh, Wh or Btu)
The total amount of energy consumed by an appliance during the preheat period (from ambient temperature to the specified operating temperature).

Preheat Rate (°F/min)
The rate at which the oven cavity heats during a preheat.

Preheat Time (min)
The time required for an appliance to heat 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 rate, in pounds per hour, at which an appliance can bring a specified food product to a specified "baked" condition.

Rated Energy Input Rate (kW, W or Btu/h)
The maximum or peak rate at which an appliance consumes energy as rated by the manufacturer and specified on the nameplate.

Resolution
The smallest change in a measured input signal that can be reliably detected by an instrument. Also known as sensitivity.

Setback Mode
Standby mode in which the oven thermostat is automatically set to a lower temperature to save energy when the oven is left idle for extended periods of time. Also known as energy-saving mode.

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

Appendix B: Additions, Deviations, and Exclusions

Additions:

- As per manufacturer's request, *two* steam performance tests were performed with steam injection times of 10- and 15-seconds.
- In addition to the ASTM standard test method for preheat and idle tests, idle and recovery tests were performed in setback/energy-saving mode with the oven operating at 250°F.

Appendix C: Appliance Specifications

Project: _____ Item# _____

C.S.I. Section 11400

BAXTER

OV500G2-EE

Rotating Double Rack Oven – Energy Efficient Gas

STANDARD ENERGY SAVING FEATURES

- Efficient 275k BTU/Hr. in-shot burner system consumes less gas, but provides high-impact results
- Improved airflow design maximizes heat exchanger use and reduces energy consumption
- Energy saving idle mode reduces oven to a stand-by temperature when left idle. Idle time and stand-by temperature can be customized to maximize energy savings in your operation
- Programmable digital control with Auto on/Auto off controls
- Three pane viewing window provides safe to touch exterior
  - Dual panes of low-E glass on the interior of the window reflect heat inward, saving energy
  - Airwash gap within the door decreases exterior temperatures
  - Single exterior pane is hinged to allow cleaning access to both sides

STANDARD FEATURES

- Stainless steel construction
- Heat exchanger with weldless construction for longer life
- Patented self-contained spherical cast steam system
- Hood with plenum and single point vent connection for Type II installations
- Field reversible bake chamber door (left or right hinged to fit your needs)
- Patented flush floor – no ramp required
- Oven body shipped split
  - Minimum intake: 37" x 105" x 62" (uncrated)
- Holds 2 single or 1 double oven rack

GAS-FIRED

c UL us

LISTED

OPTIONS & ACCESSORIES

- ❑ UL Listed, Type I hood with grease filters. Listed to UL 710 standard and meets requirements of NFPA-96.
- ❑ Manual back-up control
- ❑ Oven body shipped whole (hood, steam system & floor are field installed)
  - Minimum intake: 72" x 105" x 68.5" (uncrated)
- ❑ Kosher package
- ❑ Prison package

Area Reserved For Consultant & Contractor Approvals

BAXTER

19220 State Route 162 East
Orting, WA 98360
www.baxterbakery.com

Factory
(360) 893-5554

Customer Care
(800) 462-2778

Customer Care Fax
(937) 332-2852

BX56068 (01-12) – Printed In USA

Page 1 of 2

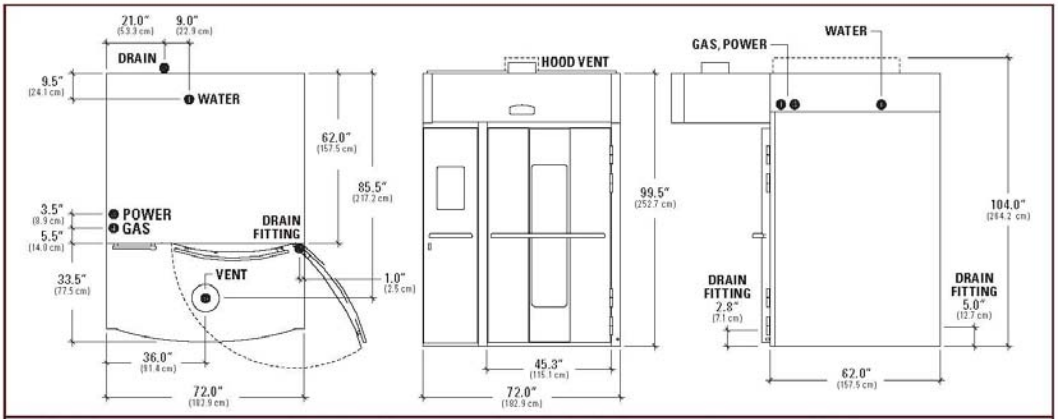
Appendix C: Appliance Specifications (Continued)

C.S.I. Section 11400

BAXTER

OV500G2-EE

Rotating Double Rack Oven – Energy Efficient Gas



- Highest Point on Oven: 105.0" (264cm).
- KD shipping weight: 4,185 lbs (1898kg).
- Rack swing diameter: 49.9" (126.7 cm)
- Freight Class: 70

UTILITIES & NOTES

❶ **Water:** ½" NPT connection. Cold water @ 30 psi minimum @ 3.0 GPM flow rate.

Note: Water supply must have the proper hardness, pH & Chloride concentration. Consult your local water company and/or water conditioner dealer before installation.

- **Recommended water hardness range:** 2-4 grains per gallon.
- **Recommended pH range:** 7.0 to 8.0.
- **Acceptable range for chloride concentration:** 0-30 ppm.

❷ **Drain:** Choose either rear or front drain and plug the connection not in use. Route to air-gap drain.

- **Front drain:** ⅜" NPTF.
- **Rear drain:** ¾" NPTF. Kit supplied to extend drain to either side of oven.

❸ **Power:** 2 Supplies required.

- 120V/60/1 — 15amp dedicated circuit. 20amp max.
- 208-240V/60/1 — 8.6amps
- 208-240V/60/3 — 4.2-4.4amps
- 440-480V/60/3 — 2.2-2.4amps

❹ **Gas:** 1-¼" NPT connection.

- **Natural gas (std):** 275k BTU/hr @ 5-14"w.c.
- **Propane (opt):** 275k BTU/hr @ 10-14"w.c.

Note: Input rates will be reduced when oven is installed at elevations above 3000' (915m). Consult factory for elevation correction.

❺ **Hood vent:** 10" dia. connection collar. Min. 900 cfm req. with 0.6" w.c. static pressure drop through hood. Customer to supply duct and ventilator fan per local code. Airflow proving switch is factory installed and integrated with burner system operation. Oven provided relay with max. 10.0 amp ½ H.P. @ 120V output for fan operation.

Ventilator fan is required. Consult local authorities to determine whether Type I (grease) or Type II (vapor) duct will be required. Hood connection suitable for connection to Type B vent, except when products of baking are grease laden.

INSTALLATION

Floor must be level within ⅛" per foot for proper installation. Slope must not exceed ¾" in all directions under the unit. Floor anchors require minimum of 1" thick solid floor substrate. Caution – To reduce the risk of fire, the appliance must be mounted on floors of non-combustible construction with non-combustible flooring and surface finish and with no combustible material against the underside thereof, or on non-combustible slabs or arches having no combustible material against the underside. Refer to NFPA 54 for further clarification.

Important:

- Do not route utilities (wiring, plumbing, etc.) in or under the non-combustible floor beneath the oven.
- 10' ceiling height required for tilt-up and service access.

The purchaser is responsible for all installation costs and for providing: Disposal of packing materials, labor to unload oven upon arrival, installation mechanics, and all local service connections including electricity, gas, water, vents and drain per local code. A factory authorized installation technician must supervise and approve any installation. In order to validate the warranty, start-up must be performed by an authorized service company. All services must comply with federal, state, and local codes.

Minimum clearances to combustible construction:

- 0 inches from sides and back
- 18 inches from top

SHORT SPECIFICATION

The oven shall be of stainless steel construction, manufactured in the United States by Baxter Mfg. The footprint shall be no larger than 72.0"W x 62.0"D x 105.0"H and shall have an integral hood with a minimum of 31" overhang to ensure proper vapor capture. The Type I hood must be UL710 Listed and have a single point exhaust. Oven shall have independent electrically interlocked air safety switches for the draft inducer and hood. Control panel shall have programmable settings with auto on/off feature and 4-step bake/roast setting.

The oven shall include an in-shot burner system with a heat exchanger consisting of 18 independent high-temperature, stainless steel tubes. The in-shot burners will have no moving parts. The oven shall also include a patented self-contained spherical cast steam system which shall convert 1.0 gallon of water into steam within 20 seconds at a temperature of 400°F or better. The field reversible oven door shall utilize three panes of glass in the viewing window to ensure a safe to the touch exterior. A patented adjustable flush floor shall be used for easy access without a ramp. The oven shall be equipped with a diagnostic center with status indicator lights and be equipped with built-in levelers.

The oven will bear the following agency approvals: UL for safety, sanitation, and gas for the U.S. & Canada, UL710 for the hood. The exhaust hood shall meet construction requirements of IMC section 507 and NFPA-96.

Manufacturer reserves the right to make changes in sizes and specifications.

BAXTER
19220 State Route 162 East
Orting, WA 98360
www.baxterbakery.com
Factory
(360) 893-5554
Customer Care
(800) 777-2828
or
(800) 462-2778
Customer Care Fax
(937) 332-2852

BX56068 (01-12) – Printed In USA

Appendix D: Appliance Test Summary Report

The information in this report is based on data generated at the PG&E Food Service Technology Center.
California consumers are not obligated to purchase any full service or other service not funded by the program.
This program is funded by the California utility rate payers under the auspices of the California Public Utilities Commission.

Manufacturer	Baxter
Model / Serial Number	OV500G2-EE / 24-2005520
Appliance	Double rack oven – gas

Report Number	501311072-R1
Report Date	August, 2011
Tested By	M. Karsz

Purpose of Testing

This testing determined the oven's energy input rate, preheat time and energy, idle energy rate, and heavy-load baking energy efficiency and baking energy rate of the oven by applying the ASTM F2093-11 Standard Test Method.

Energy Input Rate

Voltage (V)	240
Rated Energy Input Rate (Btu/h)	275,000
Measured Energy Input Rate (Btu/h)	272,056
Difference (%)	1.1
Electric Energy Rate (kW)	1.34

Preheat

Final Preheat Temperature (°F)	390.4
Duration (min)	12.56
Energy Consumption (Btu)	53,452
Electric Energy Consumption (kWh)	0.27
Preheat Rate (°F/min)	25.3

Idle

Average Cavity Temperature (°F)	397.9
Idle Energy Rate (Btu/h)	26,016
Electric Energy Rate (kW)	1.01

Heavy-Load Baking Energy Efficiency

Food Product	Apple Pies
Oven Temperature (°F)	400
Bake Time (min)	56.70
Baking Energy Rate (Btu/h)	112,960
Electric Baking Energy Rate (kW)	1.10
Energy to Food (Btu/lb)	218
Energy to Oven (Btu/lb)	421
Baking Energy Efficiency (%)	55.1 ± 1.5
Production Capacity (lb/h)	277.0 ± 4.2

Baxter OV500G2-EE
Double Rack Oven

Baxter Manufacturing

19220 State Route 162 East
Orting, WA, USA 98360
www.baxterbakery.com

Appendix D: Appliance Test Summary Report (Continued)

Setback Energy Saver Mode

Average Cavity Temperature (°F)	252.6
Idle Energy Rate (Btu/h)	9,422
Electric Energy Rate (kW)	1.15
Recovery Duration to 400°F (min)	5.00
Recovery Gas Energy Consumption (Btu)	21,586

Steam Performance: 10-second Water Injection Time

Cycle	Water Consumption (gal)	Runoff (gal)	Steam Produced (gal)
1	0.578	0.000	0.578
2	0.592	0.000	0.592
3	0.590	0.000	0.590
4	0.558	0.000	0.558
5	0.569	0.000	0.569

Steam Performance: 15-second Water Injection Time (Manufacturer's Recommended Time)

Cycle	Water Consumption (gal)	Runoff (gal)	Steam Produced (gal)
1	0.831	0.001	0.830
2	0.846	0.001	0.845
3	0.845	0.001	0.844
4	0.845	0.001	0.844
5	0.820	0.001	0.819

Appendix D: Appliance Test Summary Report (Continued)

Heavy-Load Test Data

	Test #1	Test #2	Test #3
Measured Values			
Number of Pans	30	30	30
Bake Time (min)	57.05	56.52	56.53
Gas Heating Value (Btu/ft³)	1,014	1,015	1,015
Gas Energy Consumption (Btu)	106,064	106,677	107,489
Electric Energy Consumption (kWh)	1.05	1.04	1.04
Initial Moisture Content of Apple Pies (%)	50.9	50.9	50.9
Initial Temperature of Apple Pies (°F)	0.0	1.3	3.9
Final Temperature of Apple Pies (°F)	182	182	184
Initial Weight of Apple Pies (lb)	262.11	260.38	262.81
Final Weight of Apple Pies (lb)	253.77	252.38	254.46
Weight of Sheet Pans (lb)	105.25	105.02	105.73
Calculated Values			
Sensible Energy (Btu)	30,054	29,642	29,819
Latent Fusion Energy (Btu)	19,212	19,085	19,263
Latent Vaporization Energy (Btu)	8,090	7,760	8,099
Total Energy to Food (Btu)	57,356	56,487	57,181
Energy to Food (Btu/lb)	219	217	218
Energy Consumed by Pans (Btu)	3,831	3,795	3,808
Energy Consumed by the Rack Oven (Btu)	109,648	110,227	111,039
Energy to Oven (Btu/lb of food baked)	418	423	423
Baking Energy Efficiency (%)	55.8	54.7	54.9
Gas Baking Energy Rate (Btu/h)	111,548	113,245	114,087
Electric Baking Energy Rate (kW)	1.10	1.10	1.10
Production Capacity (lb/h)	275.7	276.4	278.9

Appendix D: Appliance Test Summary Report (Continued)

Sheet Cake Browning Uniformity

Food Product	White Cake Mix
Bake Time (min)	34.02

Pan 1 (Top)

Pan 16 (Top)

Pan 7 (Middle)

Pan 22 (Middle)

Pan 15 (Bottom)

Pan 30 (Bottom)