Ultrafryer, Model PAR 3-14
Gas Fryer Performance Test

Application of ASTM Standard
Test Method F 1361-95

FSTC Report 5011.99.78

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Executive Summary

Ultrafryer Systems new ZRT Express™ (Figure ES-1) combines a powered burner with a unique heat exchanger design, all stainless steel construction, and a programmable frying computer.

Food Service Technology Center (FSTC) engineers tested the fryer under the tightly controlled conditions of the American Society for Testing and Materials' (ASTM) standard test method.[1] Fryer performance is characterized by preheat time and energy consumption, idle energy consumption rate, cooking energy efficiency, and production capacity.

Cooking performance was determined by cooking frozen French fries under three different loading scenarios (heavy—3 pounds per load, medium—1½ pounds per load, and light—¾ pound per load). The cook times for the three loading scenarios were 2.29 minutes for the heavy-load test, 2.25 minutes for the medium-load test, and 2.21 minutes for the light-load test. Production capacity includes the cooking time and the time required for the frying medium to recover to 340°F (recovery time).

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:

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[1] American Society for Testing and Materials. 1995. *Standard Test Method for the Performance of Open, Deep Fat Fryers.* ASTM Designation F 1361-95, in *Annual Book of ASTM Standards,* Philadelphia.

Executive Summary

Figure ES-1.
ZRT Express™ Gas fryer.

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

Table ES-1. Summary of Fryer Performance.

Rated Energy Input Rate (Btu/h)	90,000
Measured Energy Input Rate (Btu/h)	93,270
Preheat Time to 350°F (min) [a]	15.00
Preheat Energy to 350°F (Btu) [a]	7,450
Idle Energy Rate @ 350°F (Btu/h)	4,180
Heavy-Load Cooking Energy Efficiency (%)	64.7 ± 1.8 [b]
Medium-Load Cooking Energy Efficiency (%)	59.3 ± 3.7 [b]
Light-Load Cooking Energy Efficiency (%)	46.9 ± 3.1 [b]
Production Capacity [c] (lb/h)	72.7 ± 2.4 [b]
Frying Medium Recovery Time [c] (sec)	< 10

[a] The melt cycle was in effect until the frying medium reached 135°F.
[b] This range indicates the experimental uncertainty in the test result based on a minimum of three test runs.
[c] Based on the heavy-load cooking test with a minimum 10-second preparation time between loads.

The frying medium temperature consistently recovered to 340°F before the end of the cooking cycle during the heavy-load tests, so FSTC researchers repeated the cooking tests using extra-heavy (4-pound) loads of frozen French fries. These extra-heavy loads required a slightly longer cook time than the heavy-loads (2.43 minutes for extra-heavy-loads versus 2.29 minutes for heavy loads), but the fryer still recovered to 340°F before the fries were removed. Without a significant increase in recovery time, the 4-pound loads increased the fryer's production capacity by 25%. Table ES-2 compares the test results for the heavy and extra-heavy load tests.

Figure ES-1 illustrates the relationship between cooking energy efficiency and production rate for this fryer. Fryer production rate is a function of both the French fry cook time and the frying medium recovery time.

Figure ES-2 illustrates the relationship between the fryer's average energy consumption rate and the production rate. This graph can be used as a tool to estimate the daily energy consumption for the fryer in a real-world operation. Average energy consumption rates at 10, 30, and 50 pounds per hour are 12,410 Btu/h, 28,880 Btu/h, and 45,350 Btu/h, respectively. For an operation cooking an average of 15 pounds of food per hour over the course of the day

Table ES-2. Heavy and Extra-Heavy Load Test Results.

	Heavy-Load	Extra-Heavy Load
Load Size (lb)	3	4
French Fry Cook Time (min)	2.29	2.43
Average Recovery Time (sec)	< 10	< 10
Production Rate (lb/h)	72.7 ± 2.4 [a]	91.5 ± 1.6 [a]
Energy Consumption (Btu/lb)	899	912
Cooking Energy Rate (Btu/h)	65,370	83,480
Cooking Energy Efficiency (%)	64.7 ± 1.8 [a]	62.5 ± 2.4 [a]

[a]This range indicates the experimental uncertainty in the test result based on a minimum of three test runs.

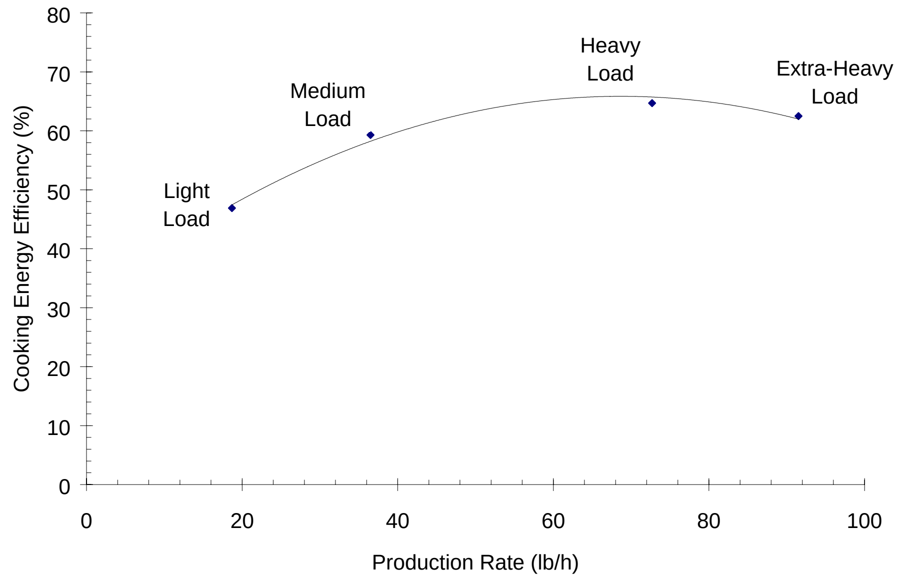

Figure ES-2.
Fryer part-load cooking energy efficiency.

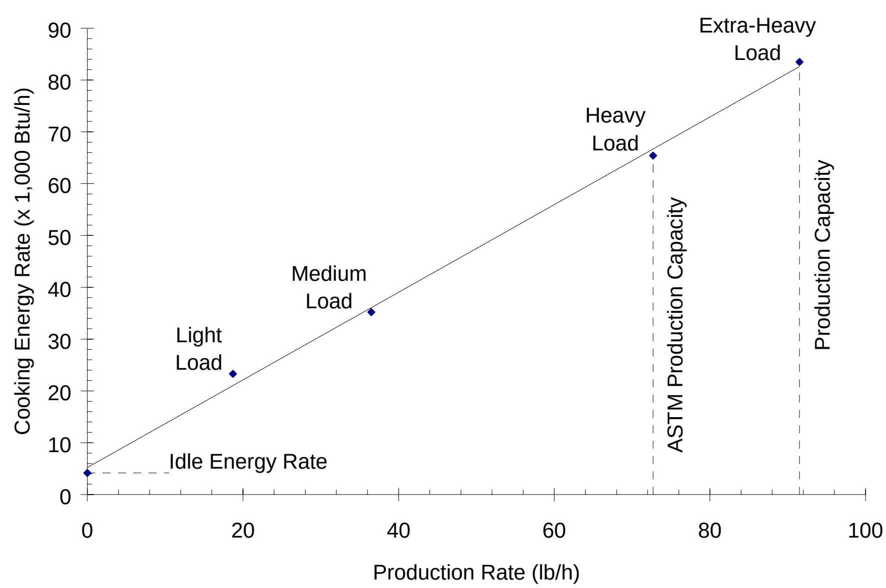

Figure ES-3.
Fryer cooking energy consumption profile.

Note: Light-load = ¾ pounds /load; medium-load = 1½ pounds/load; heavy-load = 3 pounds/load; extra-heavy load = 4 pounds/load.

(e.g., 150 lb of food over a ten hour day), the average daily energy consumption for this fryer would be 16,530 Btu/h.

The Ultrafryer Systems ZRT Express™ sets a new standard for gas fryers with a remarkable 64.7% heavy-load cooking energy efficiency. Not only does this fryer perform well during heavy-loading conditions, but under part-load conditions as well. A low idle rate contributes to fryer's high medium and light-load cooking energy efficiencies.

This fryer doesn't sacrifice cooking performance for the sake of energy efficiency either. In fact, its production rate during the heavy-load tests matches high-input electric fryers known for their throughput and this fryer is the only true "instant recovery" gas fryer that has been tested at the FSTC.[2]

With its high productivity and energy efficient design, this innovative fryer is sure to catch the attention of the food service industry.

FSTC Manager

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Senior Program Manager

Peter W. Turnbull

[2] Pacific Gas and Electric Company. 1991. *Development and Application of a Uniform Testing Procedure for Open, Deep Fat Fryers.* Report 008.1-90.22 prepared for Research and Development. San Ramon, California: Pacific Gas and Electric Company.

1 Introduction

Background

Fried foods continue to be popular on the restaurant scene. French fried potatoes are still the most common deep fried food, along with onion rings, chicken and sea food. Recent advances in equipment design have produced fryers that operate more efficiently, quickly, safely and conveniently.

With today's food service operators becoming more sophisticated in their choice of equipment, the demand for objective performance data has increased. Since Pacific Gas and Electric Company is a dual-fuel utility, the food service industry felt that it would produce unbiased data for gas and electric appliances. Pacific Gas and Electric Company would benefit by passing this performance data on to its customers, helping them to select energy efficient equipment. With support from the Electric Power Research Institute (EPRI), the Gas Research Institute (GRI), and the National Restaurant Association, Pacific Gas and Electric Company has been involved in developing test methods for commercial cooking equipment for over ten years at its Food Service Technology Center (FSTC) in San Ramon, California.

Ultrafryer Systems new fryer combines a powered burner with a unique heat exchanger design.

In 1991, FSTC researchers developed a uniform test procedure to evaluate the performance of gas and electric fryers. This test method was submitted to the American Society for Testing and Materials' (ASTM) committee F26 on Food Service Equipment, and in January 1992, it was accepted as a standard test method (Designation F 1361-95).[1] Pacific Gas and Electric Company's *Development and Application of a Uniform Testing Procedure for Open, Deep-fat Fryers* documents the developmental procedures and test results of several gas and electric fryers.[2] Other Pacific Gas and Electric Company reports document results of applying the ASTM test method to different fryers.[3,4,5,6,7]

Introduction

Fryer performance is characterized by preheat time and energy consumption, idle energy consumption rate, pilot energy consumption rate, cooking energy efficiency and production capacity.

Ultrafryer Systems new ZRT Express™ combines a powered burner with a unique heat exchanger design, all stainless steel construction, and a programmable frying computer. An integrated melt cycle prevents frying medium scorching during heat-up and a built-in filtration system makes filtering the frying medium quick and easy.

This report presents the results of applying the ASTM test method to the Ultrafryer gas fryer. The glossary in Appendix A is provided so that the reader has a quick reference to the terms used in this report.

Objectives

The objective of this report is to examine the operation and performance of the Ultrafryer gas fryer, model PAR3-14, 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. Determine the time and energy required to preheat the appliance from room temperature to 350°F.
3. Characterize the idle energy use with the thermostat set at a calibrated 350°F.
4. Document the cooking energy consumption and efficiency under three French fry loading scenarios: heavy (3 pounds per load), medium (1½ pounds per load), and light (¾ pound per load).
5. Determine the production capacity and frying medium temperature recovery time during the heavy-load test.

Based on the fryer's quick recovery during the heavy-load tests, the scope was expanded to include an extra-heavy (4-pound) load test.

Appliance Description

The thermostatically controlled fryer is heated by a single powered burner rated at 90,000 Btu/h. The flue gasses are routed through a long heat transfer tube that makes two additional passes through the frypot (see Figure 1-1). Appliance specifications are listed in Table 1-1, and the manufacturer's literature is in Appendix B.

Figure 1-1. Ultrafryer heat transfer tubes.

Table 1-1. Appliance Specifications.

Manufacturer	Ultrafryer Systems
Model	PAR 3-14
Generic Appliance Type	Open Deep Fat Fryer
Rated Input	90,000 Btu/h
Oil Capacity	50 lb
Frying Area	15" x 15"
Construction	Stainless Steel
Controls	Programmable solid state thermostat with frying computer and melt cycle.

2 Methods

Setup and Instrumentation

FSTC researchers installed the fryer 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 fryer 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 fryer with thermocouples to measure temperatures in the cold and the cooking zones and at the thermostat bulb. Additionally, four thermocouples were welded onto the heat transfer tubes, one in each

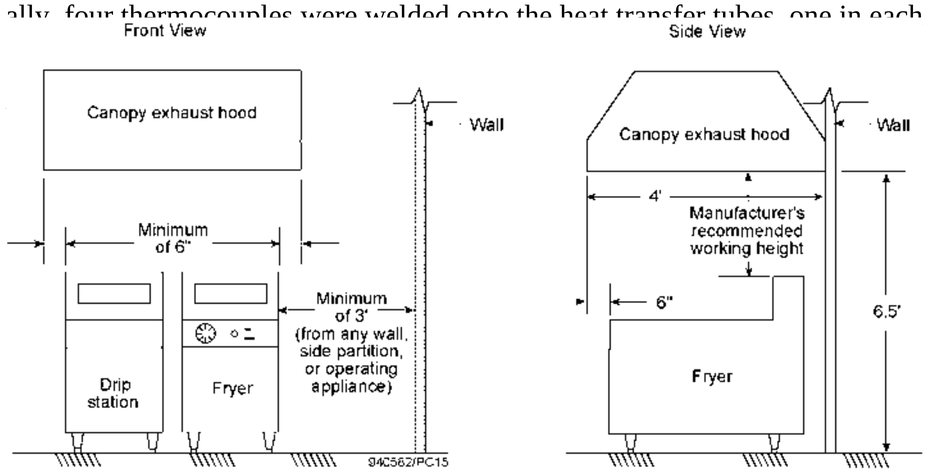

Figure 2-1.
Equipment configuration.

thermocouple was supported from above, independent of the frypot surface, so that the temperature of the cold zone reflected the frying medium temperature, not the frypot's surface temperature. The cold zone temperature was measured toward the rear of the frypot, 1/8-inch from the bottom of the pot. See Figure 2-2.

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.

The fryer was filled with Melfry Brand, partially hydrogenated, 100% pure vegetable oil for all tests except the energy input rate determination test. This test required the fryer to be filled with water to inhibit burner cycling during the test.

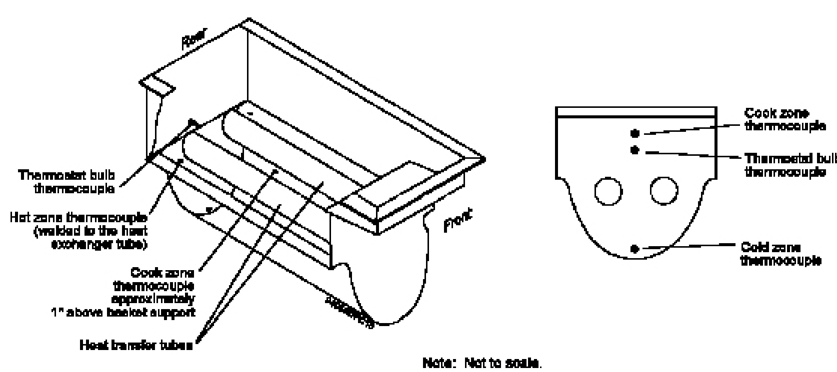

Figure 2-2. Thermocouple placement for testing.

Measured Energy Input Rate

Rated energy input rate is the maximum or peak rate at which the fryer consumes energy—as specified on the fryer'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 operating (such as preheat). For the purpose of this test, the fryer was filled with water to the frypot's indicated fill-line. The controls were set to attain maximum output and the energy consumption was monitored for a period of 15 minutes after a full rolling boil had been established. Researchers compared the measured energy input rate with the nameplate energy input rate to ensure that the fryer was operating properly.

Cooking Tests

Researchers specified Simplot® brand ¼-inch blue ribbon product, parcooked, frozen shoestring potatoes for all cooking tests. Each load of French fries was cooked to a 30% weight loss. The cooking tests involved "barreling" six loads of frozen French fries, using fry medium temperature as a basis for recovery. Each test was followed by a 10-minute wait period and was then repeated two more times. Researchers tested the fryer using 3-pound (heavy), 1½-pound (medium), and ¾-pound (light) French fry loads.

Due to the logistics involved in removing one load of cooked French fries and placing another load into the fryer, a minimum preparation time of 10 seconds was incorporated into the cooking procedure. This ensures that the cooking tests are uniformly applied from laboratory to laboratory. Fryer recovery was then based on the frying medium reaching a threshold temperature of 340°F (measured at the center of the cook zone). Reloading within 10°F of the 350°F thermostat set point does not significantly lower the average oil temperature over the cooking cycle, nor does it extend the cook time. The fryer was reloaded either after the cook zone thermocouple reached the threshold temperature or 10 seconds after removing the previous load from the fryer, whichever was longer.

The first load of each six-load cooking test was designated a stabilization load and was not counted when calculating the elapsed time and energy used. Energy monitoring and elapsed time of the test were determined after the second load contacted the frying medium. After removing the last load and allowing the fryer to recover, researchers terminated the test. Total elapsed time, energy consumption, weight of fries cooked, and average weight loss of the French fries were recorded for the last five loads of the six-load 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 fryer was operating within its specified parameters. The measured energy input rate was 93,270 Btu/h (a difference of 3.6% from the nameplate rating).

Preheat and Idle Tests

These tests show how the fryer uses energy when it is not cooking food. The preheat time allows an operator know precisely how long it takes for the fryer to be ready to cook. The idle energy rate represents the energy required to maintain the set temperature, or the appliance's stand-by losses.

Preheat Energy and Time

Researchers filled the fryer with new oil, which was then heated to 350°F at least once prior to any testing. The preheat tests were conducted at the beginning of a test day, after the oil had stabilized at room temperature overnight. This fryer was equipped with a melt cycle, which would pulse the burners until the frying medium reached a minimum of 135°F. This feature was designed to minimize scorching during preheat. The fryer's preheat required 7,450 Btu and 15 minutes. Figure 3-1 shows the energy consumption rate in conjunction with the frying medium temperature during this preheat test.

Idle Energy Rate

Once the frying medium reached 350°F, the fryer was allowed to stabilize for half an hour. Time and energy consumption were monitored for an additional two-hour period as the fryer maintained the oil at 350°F. The idle energy rate during this period was 4,180 Btu/h.

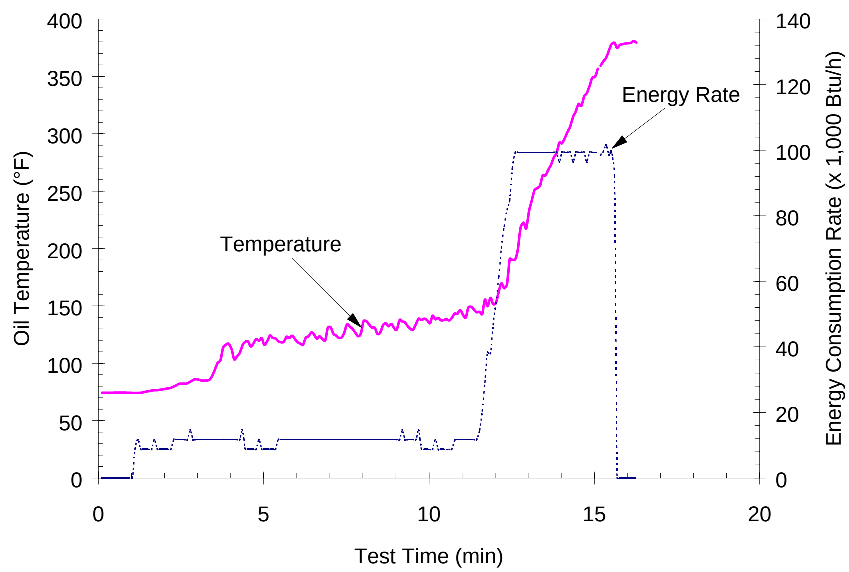

Figure 3-1.
Preheat characteristics.

Test Results

Input, preheat, and idle test results are summarized in Table 3-1.

Table 3-1. Input, Preheat, and Idle Test Results.

Rated Energy Input Rate (Btu/h)	90,000
Measured Energy Input Rate (Btu/h)	93,270
Preheat	
Time to 350°F (min)	15.00
Energy (Btu)	7,450
Rate to 350°F (°F/min)	18
Idle Energy Rate @ 350°F (Btu/h)	4,180

Results

Cooking Tests

The fryer was tested under three loading scenarios: heavy (3 pounds of fries per load), medium (1½ pounds of fries per load), and light (¾ pound of fries per load). The fries used for the cooking tests consisted of approximately 6% fat and 66% moisture, as specified by the ASTM procedure. Researchers monitored French fry cook time and weight loss, frying medium recovery time, and fryer energy consumption during these tests.

Heavy-Load Tests

The heavy-load cooking tests were designed to reflect a fryer's maximum performance. The fryer was used to cook six 3-pound loads of frozen French fries—one load after the other in rapid succession, similar to a batch-cooking procedure. Figure 3-2 shows the average temperature of the frying medium during a heavy-load test. One load was used to stabilize the fryer, and five loads were used to calculate cooking energy efficiency and production capacity. The average frying medium temperature during the heavy-load test was 339°F.

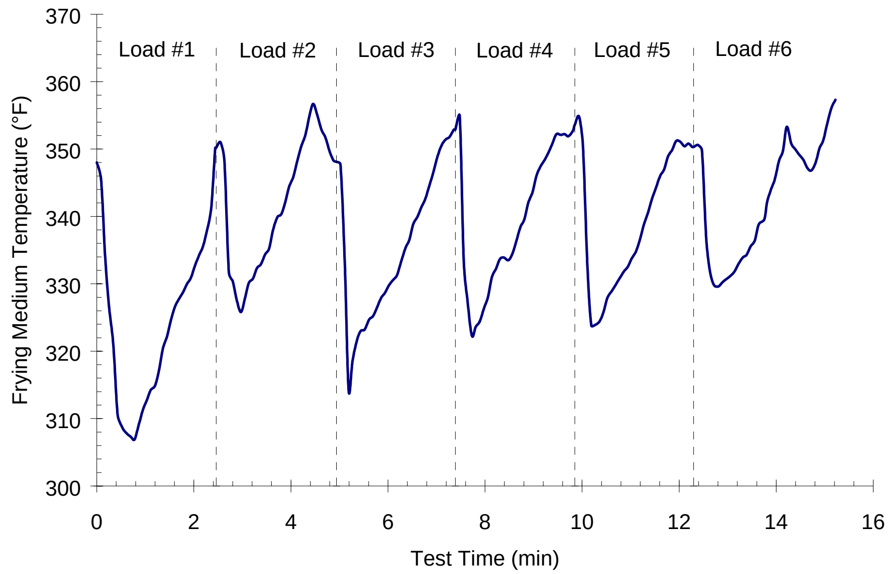

Figure 3-2. Frying medium temperature during a heavy-load test.

Since the frying medium temperature consistently recovered to 340°F before the end of the cooking cycle during the heavy-load tests, FSTC researchers decided to try cooking 4-pound French fry loads in the fryer. These extra-heavy load tests were run in the same manner as the heavy-load tests, with one load for stabilization and five additional loads for determining fryer efficiency and productivity.

The cook time was slightly longer for the extra-heavy load tests (2.43 minutes versus 2.29 minutes for heavy load tests), but the fryer still recovered to 340°F before the fries were removed. With no significant increase in recovery time, the 4-pound loads increased the fryer's production capacity by 25%. Figure 3-3 compares the fryer's temperature response while cooking a 3-pound (heavy) and a 4-pound (extra-heavy) load of frozen French fries. Production capacity includes the time required to remove the cooked fries and reload the fryer with a new batch of frozen fries (approximately 10 seconds per load). Table 3-2 compares the results of the heavy and extra-heavy load tests.

Medium- and Light-Load Tests

Medium- and light-load tests represent a more typical usage pattern for a fryer in cook-to-order applications. Since a fryer is often used to cook single basket loads in many food service establishments, these part-load efficiencies can be used to estimate the fryer's performance in an actual operation.

Both the medium- and light-load tests were conducted using a single fry basket. The medium-load tests used 1½ pounds of fries per load and the light-load tests used ¾ pounds of fries per load. Cooking energy efficiencies at 36.5 (medium) and 18.8 (light) pounds per hour were 59.3% and 46.9%, respectively.

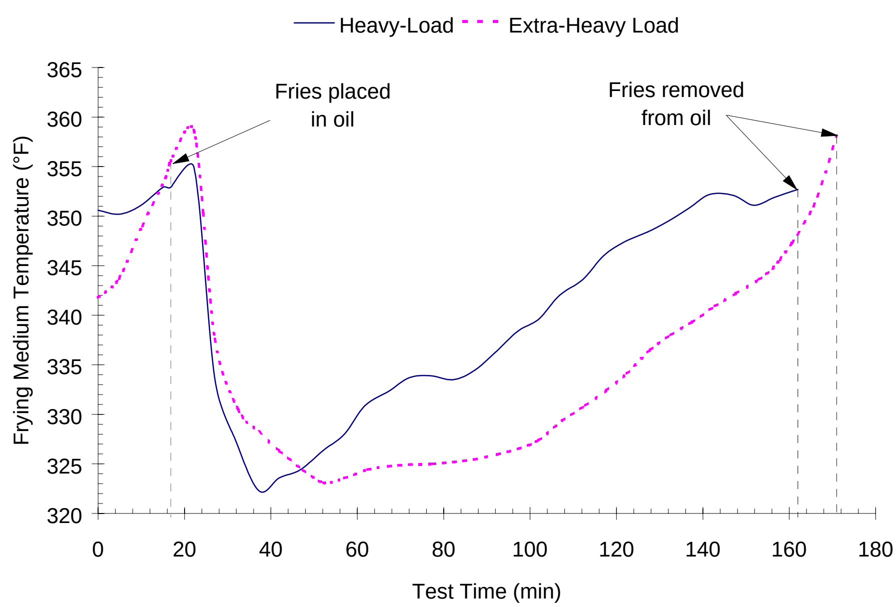

Figure 3-3.
Fryer cooking cycle temperature signature.

Table 3-2. Heavy and Extra-Heavy Load Test Results.

	Heavy-Load	Extra-Heavy Load
Load Size (lb)	3	4
French Fry Cook Time (min)	2.29	2.43
Average Recovery Time (sec)	< 10	< 10
Production Rate (lb/h)	72.7 ± 2.4	91.5 ± 1.6
Energy Consumption (Btu/lb)	899	912
Cooking Energy Rate (Btu/h)	65,370	83,480
Cooking Energy Efficiency (%)	64.7 ± 1.8	62.5 ± 2.4

Test Results

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

Cooking energy efficiency results for the ASTM heavy-load tests were 63.9%, 64.8%, and 65.3%, yielding a maximum uncertainty of 2.78% in the test results. Table 3-3 summarizes the results of the ASTM cooking energy efficiency and production capacity tests.

Figure 3-4 illustrates the relationship between cooking energy efficiency and production rate for this fryer. Fryer production rate is a function of both the French fry cook time and the frying medium recovery time. Appendix D contains a synopsis of test data for each replicate of the cooking tests.

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

	Heavy Load	Medium Load	Light Load
Load Size (pounds)	3	1½	¾
French Fry Cook Time (min)	2.29	2.25	2.21
Average Recovery Time (sec)	< 10	< 10	< 10
Production Rate (lb/h)	72.7 ± 2.4	36.5 ± 0.7	18.8 ± 0.6
Energy Consumption (Btu/lb)	899	963	1,228
Cooking Energy Rate (Btu/h)	65,370	35,160	23,090
Cooking Energy Efficiency (%)	64.7 ± 2.4	59.3 ± 3.7	46.9 ± 3.1

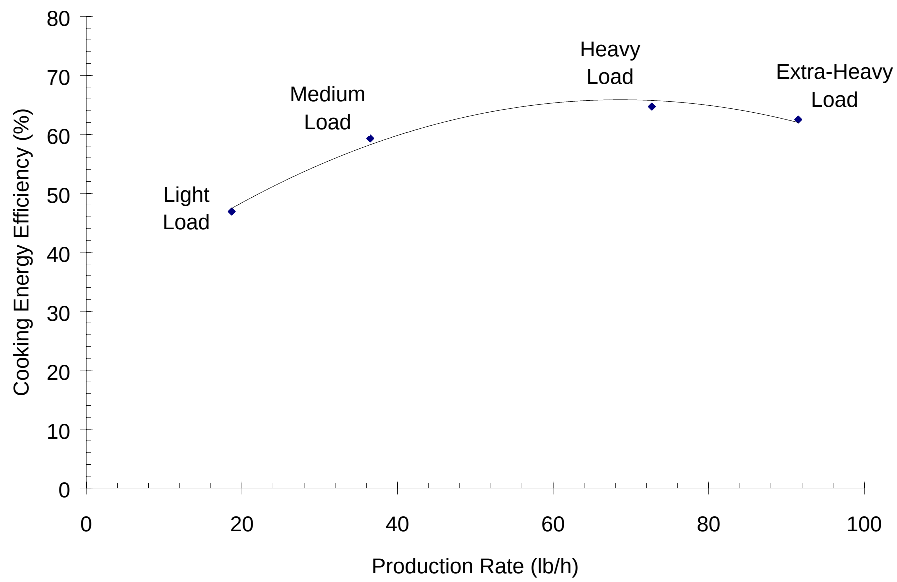

Figure 3-4.
Fryer part-load cooking energy efficiency.

Figure 3-5 illustrates the relationship between the fryer's average energy consumption rate and the production rate. This graph can be used as a tool to estimate the daily energy consumption for the fryer in a real-world operation. Average energy consumption rates at 10, 30, and 50 pounds per hour are 12,410 Btu/h, 28,880 Btu/h, and 45,350 Btu/h, respectively. For an operation cooking an average of 15 pounds of food per hour over the course of the day (e.g., 150 lb of food over a ten hour day), the average daily energy consumption for this fryer would be 16,530 Btu/h.

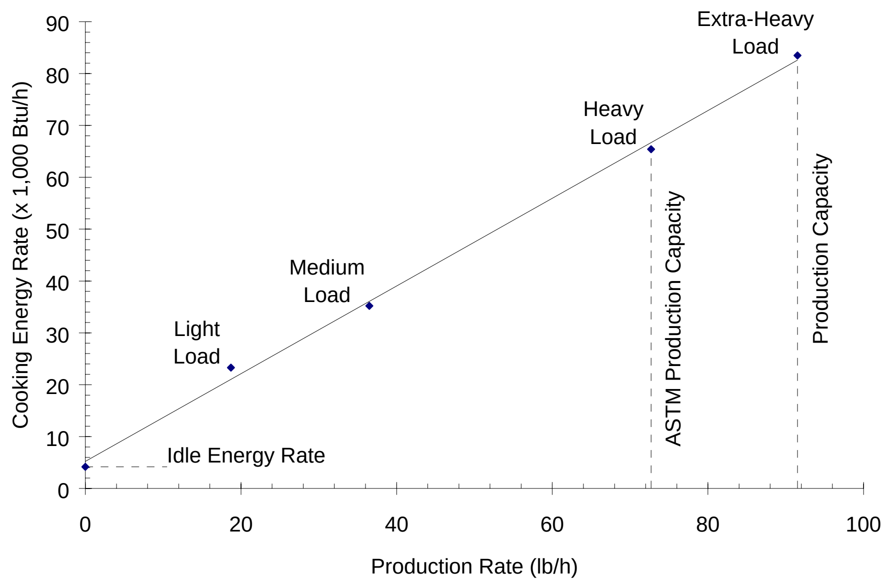

Figure 3-5.

Fryer cooking energy consumption profile.

Note: Light-load = ¾ pounds /load; medium-load = 1½ pounds/load; heavy-load = 3 pounds/load; extra-heavy load = 4 pounds/load.

4 Conclusions

The Ultrafryer will save big $$ over the competition in operating energy costs.

The Ultrafryer Systems model PAR 3-14 gas fryer demonstrated a remarkable 64.7% heavy-load cooking energy efficiency, making this the first gas fryer to break the 60% cooking energy efficiency barrier. Ultrafryer's innovative heat exchanger design transfers more heat to the frying medium than traditional designs. Not only does the fryer perform well during heavy-loading conditions, but under part-load conditions as well. The 59.3% medium-load efficiency is higher than any other gas fryer under heavy-load conditions (the next best fryer had 57.4% heavy-load efficiency), and its 46.9% light-load efficiency is among the highest tested.[1,5,6]

This fryer doesn't sacrifice cooking performance for the sake of energy efficiency either. In fact, its production rate during the heavy-load tests matches high-input electric fryers on the market known for their throughput and is the only true "instant recovery" gas fryer that has been tested at the F ood Service Technology Center.[1,3,4,5,6,7]

The frying medium averaged 339°F during the cooking tests, suggesting that this fryer could easily handle even heavier loading. A series of extra-heavy (4-pound) load tests confirmed this with a 25% increase in production capacity (from 72.7 to 91.5 pounds per hour) and only a minor drop in efficiency.

How fast does it get there? The Ultrafryer preheats in a modest 15 minutes, due to its integrated melt cycle. The melt cycle pulses the burners on and off until the frying medium reaches a minimum of 135°F, at which point an operator can manually exit the program for a full-power preheat. This can be a bit of a nuisance as it means that somebody has to watch the fryer if there's a rush to get ready for a meal period. Since most operations have switched from solid to liquid shortening, why not allow users the option of a full-power preheat? As it stands, the Ultrafryer consumed half as much energy during preheat than typical gas fryers, meaning that, at full input, this fryer puts more heat into the frying medium than other gas fryers.

The fryer exhibited a low idle rate, making it the lowest energy user in all test categories. The reduced standby losses account for the fryer's excellent part-load performance.

With its high productivity and incredibly energy efficient design, this fryer is sure to catch the attention of food service industry.

5 References

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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.

Duty Cycle = x 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.

Idle Duty Cycle = x 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 fry baskets from the fryer until the frying medium is within 10°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.

B Appliance Specifications

Appendix B includes the product literature for the Ultrafryer Systems fryer.

ZRT Express™

Ultrafryer® Systems

35-45 lb. ULTRAFRYER® Gas ZRT Express™

➤ ***Zero Recovery Time,*** high efficiency, high production 35-45 lb. fryer.

➤ ***High efficiency 90,000 BTU/h burner/heat exchanger*** provides the equivalent of 140,000 BTU/h or more on conventional atmospheric fryers.

➤ ***All Stainless Steel construction.***

➤ ***Next generation computer controls.***

➤ ***Integrated compact concealed central filtration system.***

➤ ***Flue temperatures do not exceed 500º F.***

➤ ***Cooks up to 91 lbs. of frozen French fries per hour.***

Specifications:

The ZRT Express natural (or LP) gas fryer with high efficiency 90,000 BTU/h flame retention type nozzle burner and a capacity of 35 to 45 lbs. of shortening. The 14" x 14" x 8" deep (to top of heat exchanger) fry tank is constructed of 16ga. 304L stainless steel sides back and bottom, and 14 Ga. 304L stainless steel front with insulation batts between the vat and cabinet. Standard accessories include two baskets, grid screen over heat exchanger, and clean-out rod.

The patented PAR3 heat exchanger is fabricated from 304 stainless steel and has fire cylinder at least twice the flame nozzle diameter equipped with patented multi-angle agitator. Heat exchanger furnished with blower on exhaust side to increase turbulence on the exchanger. Flue temperature not to exceed 500º F. Full width by 10-1/2" deep 16 Ga. 304 stainless steel drain apron with inverted "V" edge on front and ends. Rear lip turned down into vat 3/4" and back 1/2" on a 45° angle forming a "dog dish" lip with front of vat. Apron pitched front to rear to facilitate draining into vat. The entire cabinet is fabricated from 18 Ga. 304 stainless steel mounted on 3" neoprene casters, 2 with brakes. Below apron to be hinged control door. Door fitted with (see control options, DTMR, U11, or U21) control with built in melt cycle and default to off safety feature. Unit furnished with 1-1/4" NPT stainless steel ball valve located at front of vat, recessed in integral drain trough. Valve operated with removable drain handle. Inside of lower door equipped with drain handle hook. Fryer furnished with 6' cord and plug for 120 volt outlet to power control and blower motor. Gas line connection shall be 3/4".

Options:

Under fryer filtration system completely plumbed to allow for draining, filtering and returning shortening to vat. 304 stainless steel portable filter tub fits neatly under fryer behind lower door. The tub is complete with stainless steel crumb catcher, permanent stainless steel mesh filter with standpipe. Fryer furnished with 5 gallon per minute pump activated by plumbing valve microswitches. Shortening returned through operator selected bottom sweep nozzle or wash wand.

Self cleaning option includes 4 nozzle Automatic Vat Cleaner with 304 stainless steel shroud that attaches to the basket hanger and connects to the plumbing system via quick connect fitting. Shroud covers entire vat when in place. Nozzles designed to rinse complete interior of vat including heat exchanger.

Optional carbon filter pad holder with standpipe available in lieu of stainless steel mesh filter.

ULTRAFRYER SYSTEMS • 302 Spencer Lane • San Antonio, Texas 78201 • (800) 545-9189 • FAX (210) 737-5748

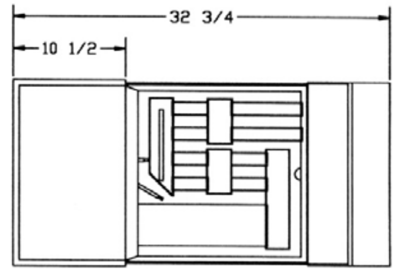
ZRT Express Gas™

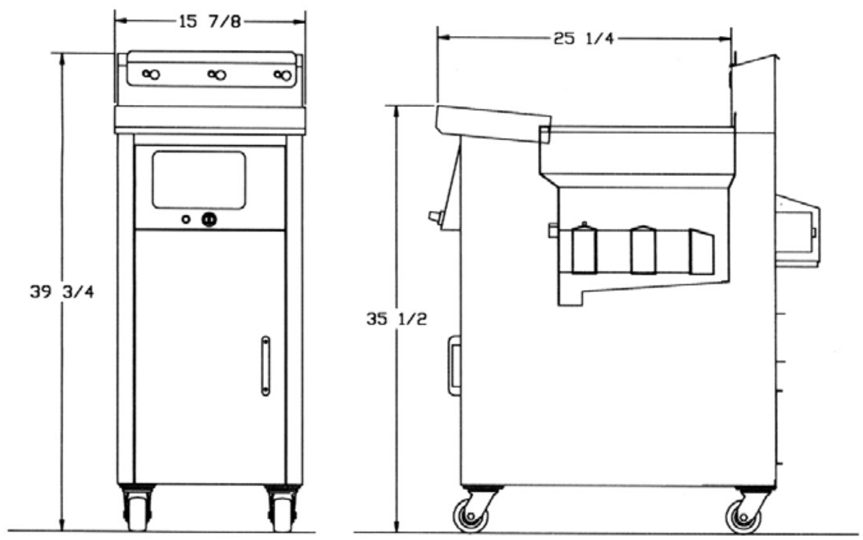
SPECIFICATIONS

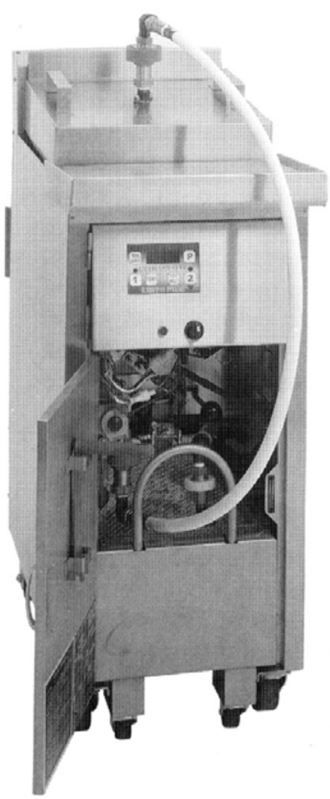
N.S.F. pending

Fryer vat size:	**14" x 14"**
Shortening capacity:	**35 lbs. to 45 lbs.** (dual shortening levels)
Energy Input Rate:	**90,000 BTU**
Approximate Shipping Weight:	**250 lbs.**

Dimensions

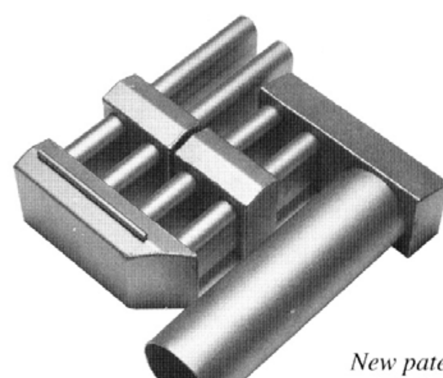






OPTIONS:

AVC Automatic Vat Cleaner and Ultrafryer self-contained filter shown at right.



New patented PAR3 heat exchanger with vortex boxes

Due to continuing engineering development and improvements, specifications are subject to change without notice.

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C Results Reporting Sheets

Manufacturer:	Ultrafryer Systems
Model:	PAR 3-14
Date:	May 1999

Section 11.1 Test Double-Sided Griddle

Description of operational characteristics: The thermostatically controlled fryer features a programmable frying computer with cook timers and an integrated melt cycle. During preheat, the melt cycle remains engaged until the frying medium reaches 135°F, at which point the user can manually exit the melt cycle and deliver full power to the burner until the fryer reaches the thermostat set point. Heat is delivered to the fryer through a powered atmospheric burner. The advanced heat exchanger routes the hot gasses through several tubes to transfer the maximum amount of available heat to the frying medium.

Section 11.2 Apparatus

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

Deviations: None.

Section 11.4 Energy Input Rate

Gas Heating Value	1016 Btu/scf
Measured	93,270 Btu/h
Rated	95,000 Btu/h
Percent Difference Between Measured and Rated	3.6%

Section 11.5 Thermostat Calibration

Thermostat Setting	350°F
Oil Temperature	351°F

Section 11.6 Preheat Energy and Time

Gas Heating Value	1016 Btu/scf
Starting Temperature	74°F
Energy Consumption	7,450 Btu
Duration	15.0 min
Preheat Rate	18°F/min

Section 11.7 Idle Energy Rate

Test Voltage	1016 Btu/scf
Idle Energy Rate @ 350°F	4,180 Btu/h

Section 11.9 Cooking Energy Efficiency and Cooking Energy Rate

Heavy Load:

Gas Heating Value	1020 Btu/scf
Cooking Time	2.29 min
Average Frying Medium Recovery Time	< 0.17 min
Production Capacity	72.7 ± 2.4 lb/h
Energy to Food	582 Btu/lb
Cooking Energy Rate	65,370 Btu/h
Energy per Pound of Food Cooked	899 Btu/lb
Cooking Energy Efficiency	64.7 ± 1.8%

Medium Load:

Gas Heating Value	1020 Btu/scf
Cooking Time	2.25 min
Average Frying Medium Recovery Time	< 0.17 min
Production Rate	36.5 ± 0.7 lb/h
Energy to Food	571 Btu/lb
Cooking Energy Rate	35,160 Btu/h
Energy per Pound of Food Cooked	963 Btu/lb
Cooking Energy Efficiency	59.3 ± 3.7%

Light Load:

Gas Heating Value	1020 Btu/scf
Cooking Time	2.20 min
Average Frying Medium Recovery Time	< 0.17 min
Production Capacity	18.7 ± 0.4 lb/h
Energy to Food	584 Btu/lb
Cooking Energy Rate	23,320 Btu/h
Energy per Pound of Food Cooked	1,248 Btu/lb
Cooking Energy Efficiency	46.9 ± 3.2%

D Cooking Energy Efficiency Data

Table D-1. Specific Heat and Latent Heat.

Specific Heat (Btu/lb, °F)	
Ice	0.500
Fat	0.400
Solids	0.200
Frozen French Fries	0.695
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)	13,637	13,490	13,337
Cook Time (min)	2.32	2.27	2.27
Total Test Time (min)	12.6	12.3	12.3
Weight Loss (%)	30.4	29.8	29.0
Initial Weight (lb)	15.00	15.00	15.00
Final Weight (lb)	10.44	10.53	10.66
Initial Fat Content (%)	6.1	6.1	6.1
Initial Moisture Content (%)	67.3	67.3	67.3
Final Moisture Content (%)	46.7	46.1	45.8
Initial Temperature (°F)	0	0	0
Final Temperature (°F)	212	212	212
Calculated Values			
Initial Weight of Water (lb)	10.09	10.09	10.09
Final Weight of Water (lb)	4.88	4.85	4.88
Sensible (Btu)	2,210	2,210	2,210
Latent - Heat of Fusion (Btu)	1,453	1.453	1,453
Latent - Heat of Vaporization (Btu)	5,052	5,079	5,053
Total Energy to Food (Btu)	8,715	8,742	8,715
Energy to Food (Btu/lb)	581	583	581
Total Energy to Fryer	13,637	13,490	13,337
Energy to Fryer (Btu/lb)	909	899	889
Cooking Energy Efficiency (%)	63.9	64.8	65.3
Cooking Energy Rate (Btu/h)	65,090	66,020	65,010
Production Rate (lb/h)	71.6	73.4	73.1
Average Recovery Time (sec)	< 10	< 10	< 10

Cooking Energy Efficiency Data

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

	Repetition #1	Repetition #2	Repetition #3
Measured Values			
Total Energy (Btu)	18,345	18,206	18,193
Cook Time (min)	2.42	2.42	2.44
Total Test Time (min)	13.1	13.1	13.2
Weight Loss (%)	29.3	29.6	29.0
Initial Weight (lb)	20.00	20.00	20.00
Final Weight (lb)	14.14	14.08	14.20
Initial Fat Content (%)	6.1	6.1	6.1
Initial Moisture Content (%)	65.1	65.1	65.1
Final Moisture Content (%)	44.7	43.0	44.4
Initial Temperature (°F)	0	0	0
Final Temperature (°F)	212	212	212
Calculated Values			
Initial Weight of Water (lb)	13.01	13.01	13.01
Final Weight of Water (lb)	6.32	6.05	6.31
Sensible (Btu)	2,947	2,947	2,947
Latent - Heat of Fusion (Btu)	1,874	1,874	1,874
Latent - Heat of Vaporization (Btu)	6,495	6,754	6,505
Total Energy to Food (Btu)	11,316	11,574	11,326
Energy to Food (Btu/lb)	566	579	566
Total Energy to Fryer	18,345	18,206	18,193
Energy to Fryer (Btu/lb)	917	910	910
Cooking Energy Efficiency (%)	61.7	63.6	62.3
Cooking Energy Rate (Btu/h)	84,150	83,710	82,570
Production Rate (lb/h)	91.7	92.0	90.8
Average Recovery Time (sec)	< 10	< 10	< 10

Cooking Energy Efficiency Data

Table D-4. Medium-Load Test Data.

	Repetition #1	Repetition #2	Repetition #3
Measured Values			
Total Energy (Btu)	7,202	7,110	7,356
Cook Time (min)	2.25	2.25	2.25
Total Test Time (min)	12.3	12.3	12.3
Weight Loss (%)	29.7	30.3	29.9
Initial Weight (lb)	7.50	7.50	7.50
Final Weight (lb)	5.28	5.23	5.26
Initial Fat Content (%)	6.1	6.1	6.1
Initial Moisture Content (%)	66.6	66.6	66.6
Final Moisture Content (%)	45.7	46.9	47.6
Initial Temperature (°F)	0	0	0
Final Temperature (°F)	212	212	212
Calculated Values			
Initial Weight of Water (lb)	4.99	4.99	4.99
Final Weight of Water (lb)	2.41	2.45	2.50
Sensible (Btu)	1,105	1,105	1,105
Latent - Heat of Fusion (Btu)	719	719	719
Latent - Heat of Vaporization (Btu)	2,505	2,462	2,416
Total Energy to Food (Btu)	4,329	4,286	4,240
Energy to Food (Btu/lb)	577	571	565
Total Energy to Fryer	7,202	7,110	7,356
Energy to Fryer (Btu/lb)	960	948	981
Cooking Energy Efficiency (%)	60.1	60.3	57.6
Cooking Energy Rate (Btu/h)	35,080	34,600	35,800
Production Rate (lb/h)	36.5	36.5	36.5
Average Recovery Time (sec)	< 10	< 10	< 10

Table D-5. Light-Load Test Data.

	Rep #1	Rep #2	Rep #3	Rep #4	Rep #5
Measured Values					
Total Energy (Btu)	4,860	4,483	4,978	4,320	4,390
Cook Time (min)	2.24	2.22	2.22	2.18	2.17
Total Test Time (min)	12.2	12.1	12.2	11.7	11.6
Weight Loss (%)	31.0	30.6	30.5	30.5	30.5
Initial Weight (lb)	3.75	3.75	3.75	3.75	3.75
Final Weight (lb)	2.59	2.60	2.61	2.61	2.61
Initial Fat Content (%)	6.1	6.1	6.1	6.1	6.1
Initial Moisture Content (%)	66.6	66.6	66.6	64.1	64.1
Final Moisture Content (%)	44.8	45.0	46.8	44.0	44.7
Initial Temperature (°F)	0	0	0	0	0
Final Temperature (°F)	212	212	212	212	212
Calculated Values					
Initial Weight of Water (lb)	2.50	2.50	2.50	2.40	2.40
Final Weight of Water (lb)	1.16	1.17	1.22	1.15	1.17
Sensible (Btu)	553	553	553	553	553
Latent - Heat of Fusion (Btu)	359	359	359	346	346
Latent - Heat of Vaporization (Btu)	1,296	1,284	1,239	1,219	1,201
Total Energy to Food (Btu)	2,208	2,196	2,151	2,118	2,100
Energy to Food (Btu/lb)	589	586	574	565	560
Total Energy to Fryer	4,860	4,483	4,978	4,320	4,390
Energy to Fryer (Btu/lb)	1,296	1,196	1,327	1,152	1,171
Cooking Energy Efficiency (%)	45.4	49.0	43.2	49.0	47.8
Cooking Energy Rate (Btu/h)	23,840	22,300	24,420	22,130	22,730
Production Rate (lb/h)	18.4	18.7	18.4	19.2	19.4
Average Recovery Time (sec)	< 10	< 10	< 10	< 10	< 10

Cooking Energy Efficiency Data

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

	Cooking Energy Efficiency			Production Capacity
	Heavy Load	Medium Load	Light Load	
Replicate #1	63.9	60.1	45.4	71.6
Replicate #2	64.8	60.3	49.0	73.4
Replicate #3	65.3	57.6	43.2	73.1
Replicate #4	—	—	49.0	—
Replicate #5	—	—	47.8	—
Average	64.7	59.3	46.9	72.7
Standard Deviation	0.73	1.48	2.53	0.97
Absolute Uncertainty	1.80	3.66	3.13	2.41
Percent Uncertainty	2.78	6.17	6.68	3.31