Vulcan ER50D
Electric Fryer
Performance Tests

Application of ASTM Standard
Test Method F 1361-07

FSTC Report 5011.08.04

Food Service Technology Center
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Specific appreciation is extended to Vulcan for supplying the FSTC with a electric fryer, Model ER50D. for controlled testing in the appliance laboratory.

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Vulcan ER50D Fryer.

Vulcan's ER50D electric fryer features low watt density ribbon elements with a rated input of 17.0 kW. The fryer vat is of a stainless construction with a nominal frying oil capacity of 50 lb. A solid state control panel allows for temperature adjustments, multiple melt modes and two countdown timers. Figure ES-1 illustrates the ER50D fryer, as tested at the Food Service Technology Center (FSTC).

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 heavy-load conditions—3 pounds per load. The heavy-load cook time for the ER50D fryer was 2.33 minutes. 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:

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

[1] American Society for Testing and Materials. 2007. *Standard Test Method for the Performance of Open, Deep Fat Fryers.* ASTM Designation F 1361-07, in *Annual Book of ASTM Standards,* West Conshohocken, PA.

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

Table ES-1. Summary of Fryer Performance.

Rated Energy Input Rate (kW)	17.0
Measured Energy Input Rate (kW)	17.7
Preheat Time to 350°F (min)	6.30
Preheat Energy to 350°F (kWh)	1.76
Idle Energy Rate @ 350°F (kW)	0.63
Heavy-Load Cooking-Energy Efficiency (%)[a]	85.3 ± 1.6
Light-Load Cooking-Energy Efficiency (%)[a]	71.8 ± 4.0
Production Capacity (lb/h)[a]	71.9 ± 4.7
Average Frying Recovery Time (sec)[b]	< 10

[a] This range indicates the experimental uncertainty in the test result based on a minimum of three test runs.
[b] Based on the heavy-load cooking test with a minimum 10-second preparation time between loads.

Vulcan's ER50D electric fryer required 2.33 minutes to cook a single heavy-load test (3-pounds) of French fries, with the fryer recovered and ready-to-cook another load of French fries within the 10-second reload time specified by the test method. The rapid cook time produced a production capacity of 71.0 pounds of French fries per hour, while achieving a cooking-energy efficiency of 85.3%.

Figure ES-2 illustrates the relationship between cooking-energy efficiency and production rate for the fryer. Figure ES-3 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 and probable demand for the fryer in a real-world operation. Average energy consumption rates at 10, 30, and 50 pounds per hour were 2.6 kW, 6.5 kW, and 10.3 kW, 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 probable demand contribution for this fryer would be 3.6 kW.

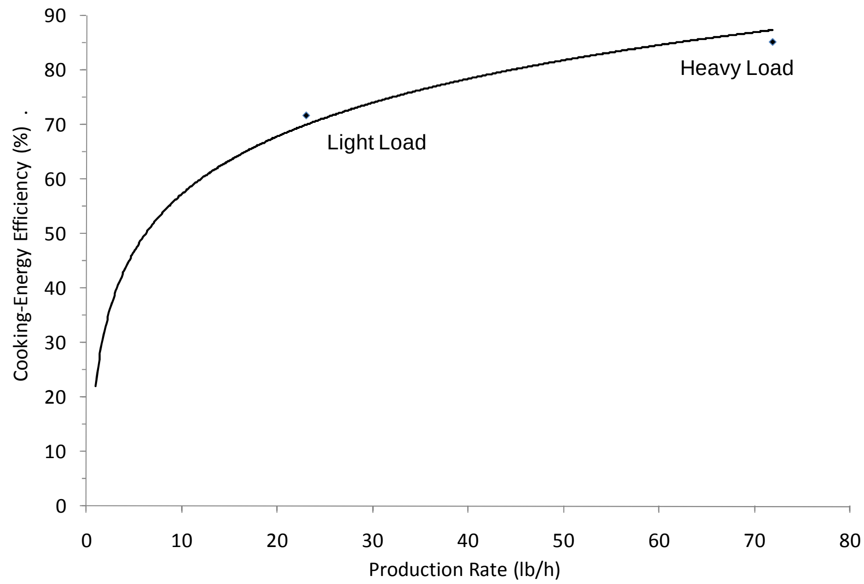

Figure ES-2.
Fryer part-load cooking-energy efficiency.

Note: Heavy-load = 3 pounds/load, Light-load = ¾ pounds/load.

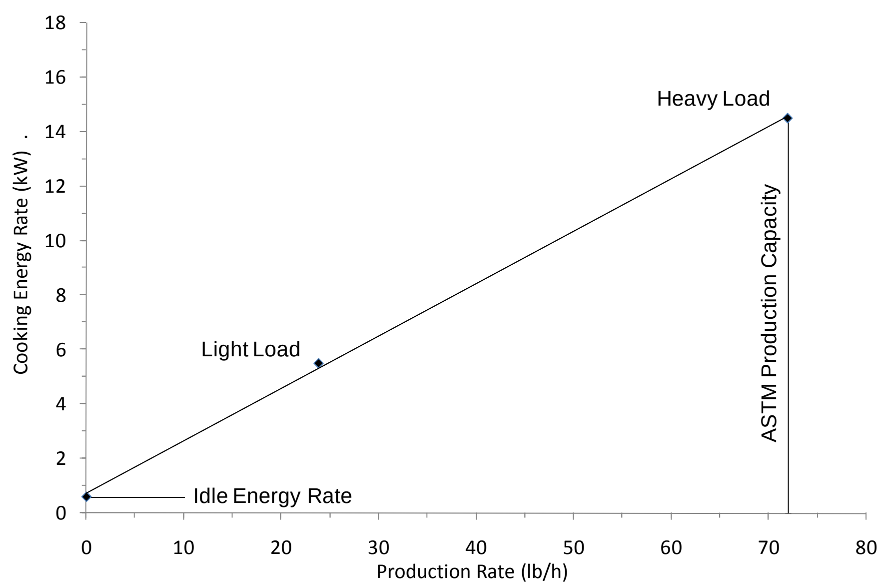

Figure ES-2.
Fryer cooking energy consumption profile.

Note: Heavy-load = 3 pounds/load, Light-load = ¾ pounds/load.

The ASTM test results can be used to estimate the annual energy consumption for the fryer 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 cooking costs) and the annual operating cost, using the ASTM test data. Table ES-2 summarizes the estimated annual energy consumption and associated cost based on the model.

Table ES-2. Estimated Fryer Energy Consumption and Cost.

Preheat Energy (kWh/day)	1.76
Idle Energy (kWh/day)	6.06
Cooking Energy (kWh/day)	21.2
Annual Energy (kWh/year)	10,585
Annual Cost ($/year)[a]	1,059

[a] Fryer energy costs are based on $0.10/kwh.

The estimated operational cost of the ER50D electric fryer is $1,059 per year. The model assumes the fryer is used to cook 100 pounds of French fries over a 12-hour day, 365 days a year. The model also assumes one preheat each day with the remaining on-time being in an idle (ready-to-cook) state.

A very low idle energy rate of 0.63 kW means reduced operating costs for a restaurateur. Rapid oil temperature recovery and speedy cook times during operation provide a food service operator with a workhorse fryer that can handle high volumes, while its 85.3% cooking-energy efficiency securely places it among the top performing electric fryers on the market.

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 fish. Recent advances in equipment design have produced fryers that operate more efficiently, quickly, safely and conveniently.

Dedicated to the advancement of the food service industry, the Food Service Technology Center (FSTC) has focused on the development of standard test methods for commercial food service 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 test methods, approved and ratified by the American Society for Testing and Materials (ASTM), allow benchmarking of equipment such that users can make meaningful comparisons among available equipment choices. Since the development of the ASTM test method for fryers in 1991[1,2], the FSTC has tested a wide range of gas and electric fryers.[3-31] End-use customers and commercial appliance manufacturers consider the FSTC to be the national leader in commercial food service equipment testing and standards, sparking alliances with several major chain customers to date.

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

Vulcan's ER50D electric fryer features an insulated stainless steel open frypot and backsplash design with low watt density ribbon style elements. A solid-state control panel allows for temperature adjustments, multiple melt modes and two countdown timers. An optional control panel allows for the programming of multiple food product. An integrated melt cycle prevents solid frying medium from scorching during preheat.

This report presents the results of applying the ASTM test method to the Vulcan ER50D electric 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 Vulcan's ER50D, 14-inch electric fryer at an input rating of 17.0 kW 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 while cooking two French fry loading scenarios: heavy- (3 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.
6. Estimate the annual operating cost for the fryer using a standard cost model.

Appliance Description

Vulcan's ER50D, 14-inch electric fryer has an input rating of 17.0 kW. The fry pot is of stainless steel construction with heat transferred into the frying medium through low watt density ribbon elements located in the fry vat. Insulation surrounds the side of the frypot to improve heat retention. The fryer features a solid-state control panel, which allows for temperature adjustments, multiple melt modes and two countdown timers.

Introduction

Figure 1-1.
Vulcan ER50D frypot.

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

Table 1-1. Appliance Specifications.

Manufacturer	Vulcan
Model	ER50D
Generic Appliance Type	Open Deep Fat Fryer
Rated Input	17.0 kW
Frying Area	14″ x 15.25″
Oil Capacity	50 lb
Controls	Solid state
Construction	Stainless Steel

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 fryers and the edge of the hood. All test apparatus was installed in accordance with Section 9 of the ASTM test method.[1] See Figure 2-1.

Researchers instrumented the fryer with thermocouples to measure temperatures in the cold and the cooking zones and at the thermostat bulb. Two thermocouples were placed in the cook zone, one in the geometric center of the frypot, approximately 1 inch above the fry basket support, and the other at the tip of the thermostat bulb. The cold zone 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

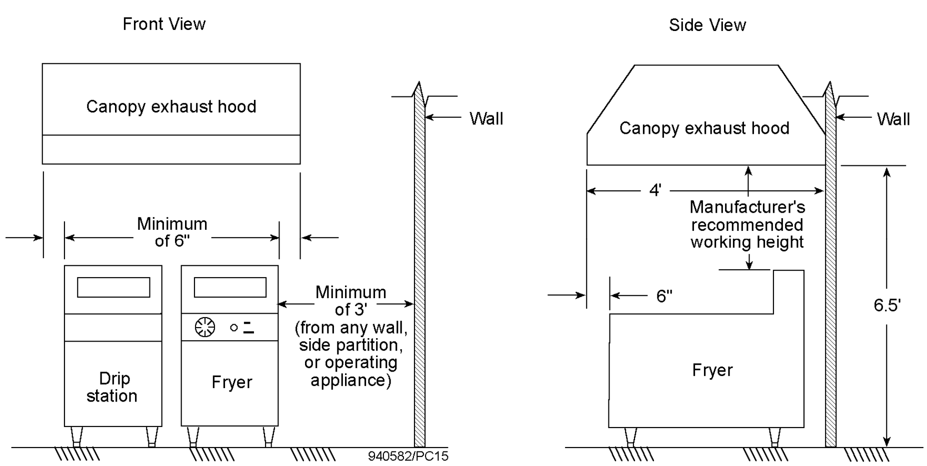

Figure 2-1. Equipment configuration.

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).

Power and energy were measured with a watt/watt-hour transducer that generated an analog signal for instantaneous power and a pulse for every 10 Wh. A voltage regulator, connected to the fryers, maintained a constant voltage for all tests. Control energy was monitored with a watt-hour transducer that generated a pulse for every 0.00001 watt-hours. The energy meters and thermocouples were connected to a data logger which recorded data every five seconds.

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 heater cycling during the test.

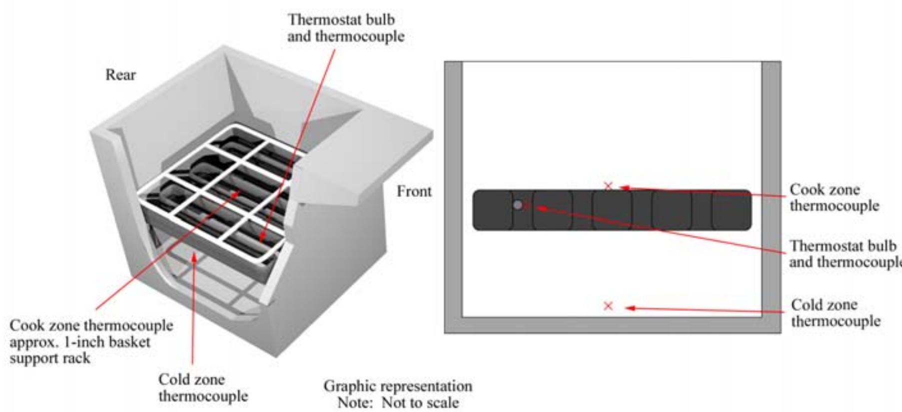

Figure 2-2. Thermocouple placement for testing.

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 elements are energized (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 ¼-inch, blue ribbon product, par-cooked, 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) 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 did not significantly lower the average oil temperature over the cooking cycle, nor did 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 as a stabilization load and was not counted when calculating the elapsed time and energy consumed. 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.

Each loading scenario (heavy and light) was replicated a minimum of three times. 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.

Energy Cost Model

Fryer operating cost was calculated based on a combination of test data and assumptions about typical fryer usage. This provides a standard method for estimating fryer energy consumption based on ASTM performance test results. The examples contained in the operating cost model are for informational purposes only, and should not be considered an absolute.

The model assumed a typical twelve-hour day, with the operation being broken down into three operating scenarios; preheat, idle and cooking. One preheat is assumed per day with the remainder being split between idle and cooking periods. During the day, 100 lbs. of food would be cooked. The idle time was calculated as the total time of operation minus preheat and cooking times. The total daily energy usage was calculated based on the fryer's energy consumption in each of these operating scenarios.

Details of this calculation can be found in Appendix E of this report.

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 fryer was operating within its specified parameters. The measured energy input rate was 17.7 kW (a difference of 4.2% 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 to 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 of 350°F, 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. While Vulcan's cooking computer has an integrated melt cycle to prevent scorching of solid shortening the melt cycle was disabled for the preheat test to accommodate the liquid shortening specified in the test method. Vulcan's ER50D fryer was ready to cook in 6.30 minutes, while consuming 1.76 kWh during the preheat. Figure 3-1 shows the fryer's preheat characteristics.

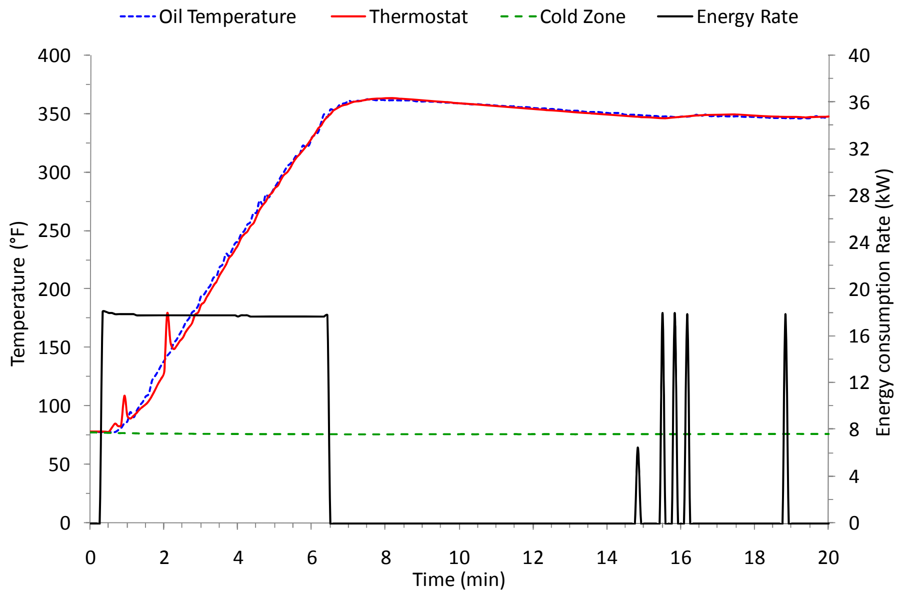

Figure 3-1.
Vulcan ER50D preheat characteristics.

Idle Energy Rate

Once the frying medium reached 350°F, the fryer was allowed to stabilize for half an hour. Time and energy consumption was monitored for an additional two-hour period as each fryer maintained the oil at 350°F. The idle energy rate during this period was 0.63 kW.

Test Results

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

Results

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

Rated Energy Input Rate (kW)	17.0
Measured Energy Input Rate (kW)	17.7
Percentage Difference (%)	4.2
Preheat	
Time to 350°F (min)	6.30
Energy Consumption (kWh)	1.76
Preheat Rate to 350°F (°F/min)	41.6
Idle	
Idle Energy Rate (kW)	0.63

Cooking Tests

The fryer was tested under two loading scenarios: heavy (3 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 70% moisture. 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. Figures 3-2 shows the average temperature of the frying medium at the center of the cook zone during the heavy-load tests.

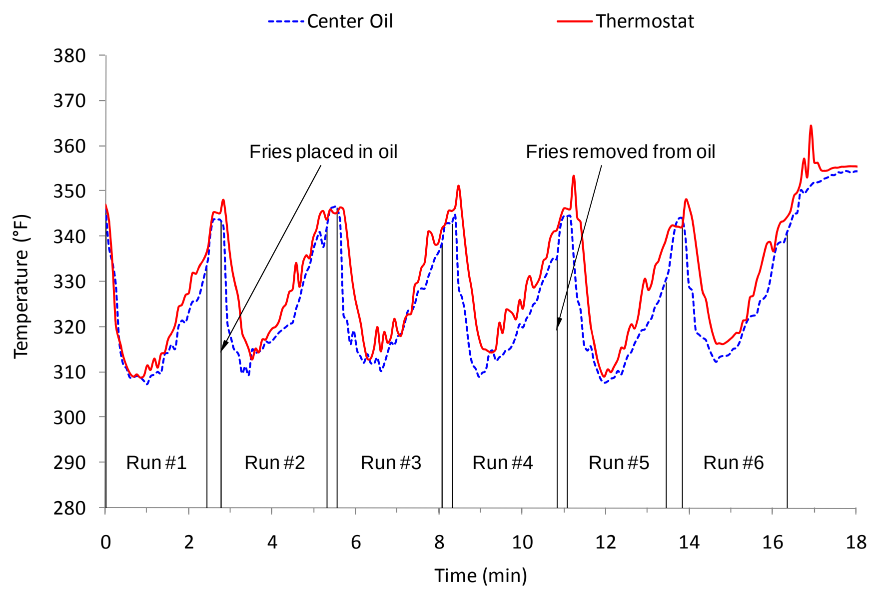

Figure 3-2.
Frying medium temperarture during a heavy-load test for the ER50D fryer.

The first load was used to stabilize the fryer, and the remaining five loads were used to calculate cooking-energy efficiency and production capacity. The average frying medium temperature during the heavy-load tests was 323°F. The heavy-load cook time for the fryer was 2.33 minutes, and the fryer was recovered within the 10-second reload time. Figure 3-3 illustrates the temperature response of the Vulcan fryer while cooking a 3-pound 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).

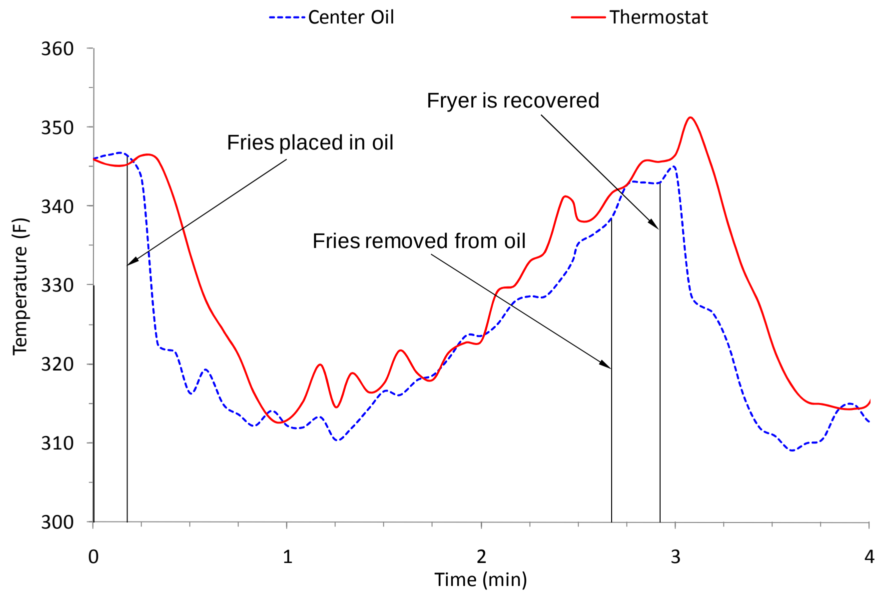

Figure 3-3.
Fryer cooking cycle temperature signature.

Light-Load Tests

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, this partial-load efficiency can be used to estimate the fryer's performance in an actual operation.

Light-load tests were conducted using a single fry basket. The light load tests used ¾ pounds of fries per load and resulted in a cooking-energy efficiency of 71.8% at a production rate of 23.0 lb/h.

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.

Heavy-load cooking-energy efficiency results were 86.0%, 84.7% and 85.2%, yielding a maximum uncertainty of 1.6%. Table 3-2 summarizes the results of the ASTM cooking-energy efficiency and production capacity tests.

Table 3-2. Cooking-Energy Efficiency and Production Capacity Test Results.

	Heavy-Load	Light-Load
Load Size (lb)	3.0	0.75
French Fry Cook Time (min)	2.33	1.84
Average Recovery Time (sec)	< 10	< 10
Production Rate (lb/h) [a]	71.9 ± 4.7	23.0 ± 0.6
Energy to Food (Btu/lb)	587	583
Cooking Energy Rate (kW)	14.5	5.47
Energy per Pound of Food Cooked (Btu/lb)	689	813
Cooking-Energy Efficiency (%)[a]	85.3 ± 1.6	71.8 ± 4.0

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

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.

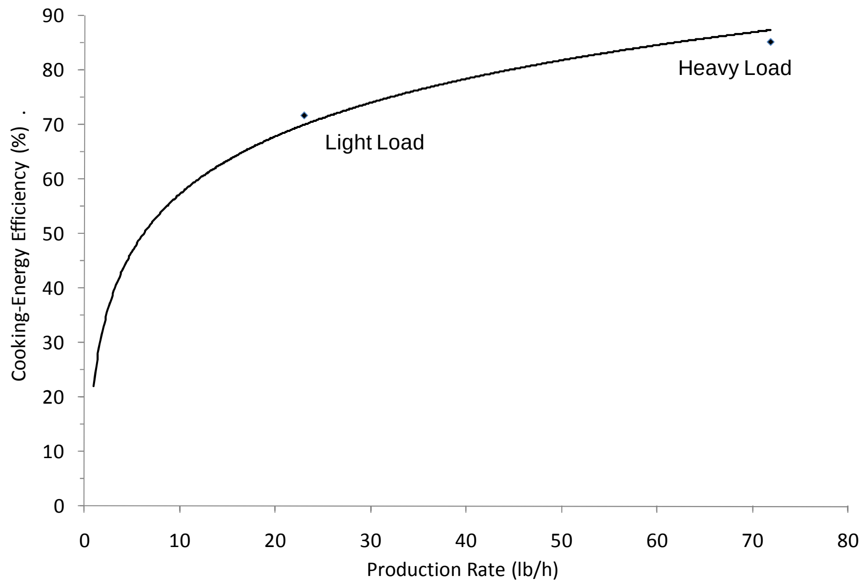

Figure 3-4.
Fryer part-load cooking-energy efficiency .

Note: Heavy-load = 3 pounds/load, Light-load = ¾ pounds/load.

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 and probable demand for the fryer in a real-world operation. Average energy consumption rates at 10, 30, and 50 pounds per hour were 2.6 kW, 6.5 kW, and 10.3 kW, 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 probable demand contribution for this fryer would be 3.6 kW.

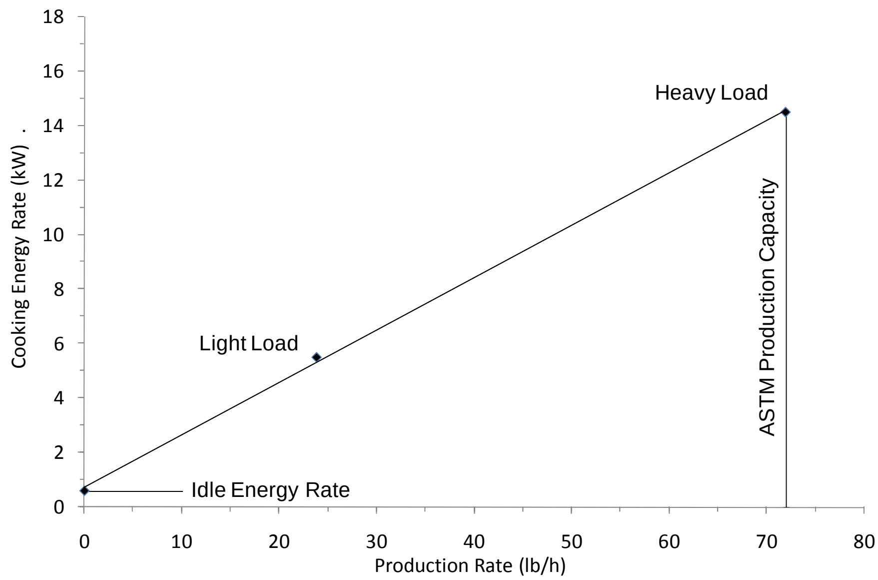

Figure 3-5.
Fryer cooking energy consumption profile.

Note: Heavy-load = 3 pounds/load, Light-load = ¾ pounds/load.

Energy Cost Model

The test results can be used to estimate the annual energy consumption for the fryer 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 cooking costs) and the annual operating cost, using the ASTM test data. For this model, the fryer was used to cook 100 pounds of fries over a 12-hour day, with one preheat per day, 365 days per year. The idle (ready-to-cook) time for the fryer was determined by taking the difference between the total daily on-time (12 hours) and the equivalent full-load cooking time. This approach produces a more accurate estimate of the operating cost for the fryer. Table 3-3 summarizes the estimated energy consumption and cost based on the model.

Table 3-3. Estimated Fryer Energy Consumption and Cost.

Preheat Energy (kWh/day)	1.76
Idle Energy (kWh /day)	6.06
Cooking Energy (kWh /day)	21.2
Annual Energy (kWh/year)	10,585
Annual Cost ($/year)[a]	1,059

[a] Fryer energy costs are based on $0.10/kwh.

4 Conclusions

Vulcan's ER50D electric fryer exhibited solid performance under the rigorous conditions of the ASTM *Standard Test Method for the Performance of Open Deep Fat Fryers* (F1361-07). Upon start up the fryer reached a ready-to-cook state of 350°F in a very rapid 6.3 minutes consuming 1.76 kWh in the process. Once heated studies have shown that fryers spend a good portion of the day in a ready-to-cook standby (idle) mode.[31] The ER50D fryer exhibited an extremely low idle energy rate of 0.63 kW. This is 37% lower than a typical electric fryer which idles at approximately 1.0 kW. To a restaurateur, a low idle rate means lower operating costs for the Vulcan fryer.

During heavy-load testing, the ER50D fryer achieved a solid production capacity of 71.9 pounds of French fries per hour, while demonstrating a very competitive cooking-energy efficiency of 85.3%. The fryer was able to cook a 3-pound load of French fries in 2.33 minutes, and was recovered and ready to cook another load of French fries within the 10 second load/reload period.

The estimated operational cost of the ER50D electric fryer is $1,059 per year. The model assumes the fryer is used to cook 100 pounds of French fries over a 12-hour day, 365 days a year. The model also assumes one preheat each day, with the remaining on-time being an idle (ready-to-cook) state.

The combination of high efficiency, and rapid oil temperature recovery and speedy cook times during operation provide a food service operator with a workhorse fryer that can handle high production volumes, while going easy on the electric meter.

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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 holding or maintaining 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.

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

Glossary

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 warm 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.

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 Vulcan ER50D fryer.

Table B-1. Appliance Specifications.

Manufacturer	Vulcan
Model	ER50D
Generic Appliance Type	Open Deep Fat Fryer
Rated Input	17.0 kW
Frying Area	14″ x 15.25″
Oil Capacity	50 lb
Controls	Solid State
Construction	Stainless Steel

Item # ___________________________

C.S.I. Section 11420

1ER50 SERIES

FREE STANDING ELECTRIC FRYERS

Model 1ER50D

NSF listed. CSA design certified. (C US)

- ☐ **1ER50D** Solid state controls
- ☐ **1ER50C** Programmable computer controls

STANDARD FEATURES

- ☐ Stainless Steel Cabinet
- ☐ 6" adjustable nickel plated, noncorrosive legs.
- ☐ 16 gauge stainless steel fry tank, 50 lbs. capacity.
- ☐ Twelve year limited fry tank warranty.
- ☐ 1-1/4" full port ball type drain valve.
- ☐ 17 KW low watt density ribbon style heating elements.
- ☐ Three fat melt modes.
- ☐ High limit control.
- ☐ Twin fry baskets with plastic coated handles.
- ☐ 208 volt, 3 phase.
- ☐ One year limited parts and labor warranty.

SPECIFICATIONS:

Electric deep fat fryer, Vulcan-Hart Model No. (1ER50D) (1ER50C). Cabinet is stainless steel with 6" legs. 16 gauge stainless steel fry tank holds 50 lbs. of frying compound. 1$^{1}/_{4}$" full port ball type drain valve. 17 KW low watt density ribbon style heating elements. (Solid state) (Programmable computer) temperature controls are adjustable from 200 to 390 F, and include a fat melt cycle and high limit control. Twin fry baskets.
Power supply is 208 volt, 60 Hz, 3 phase.

Overall dimensions: 15$^{1}/_{2}$"w x 34$^{1}/_{8}$"d x 41$^{1}/_{16}$"h.
Working height is 36$^{1}/_{4}$".

NSF listed. CSA design certified.

SPECIFY VOLTAGE WHEN ORDERING.

CONTROLS:

1ER50D Solid state digital read temperature control. Accurate temperature control 200 F to 390 F within +/- 2 . Multiple fat melt modes, fast recovery, boil out mode and two countdown timers.

1ER50C Computer control digital read temperature control. Accurate temperature control 200 F to 390 F within +/- 2 . Multiple fat melt modes, fast recovery and boil out mode. Ten programmable product keys and ten countdown timers. Secondary and advanced programming options.

OPTIONS

- ☐ 480 volt, 3 phase. (Separate 120 volt, 20 amp electric supply required.)

ACCESSORIES

- ☐ Set of 4 casters (2 locking).
- ☐ Extra set of twin fry baskets - 6.5"w x 13.25"d x 6"h
- ☐ Large single fry basket - 13"w x 13.25"d x 5.5"h
- ☐ Tri-baskets - 4.25"w x 13.25"d x 5.5"h
- ☐ Tank cover - Flat work top surface design.
- ☐ Flanged feet.
- ☐ Second year extended limited parts and labor warranty.

VULCAN

REGISTERED FIRM UL
A2780
ISO9001
Vulcan-Hart Co.

MODELS: 1ER50 SERIES Free Standing Electric Fryers

VULCAN-HART COMPANY, P.O. BOX 696, LOUISVILLE, KY 40201, TEL. 1-800-814-2028
502-778-2791 QUOTE & ORDER FAX: 1-800-444-0602

1ER50 SERIES

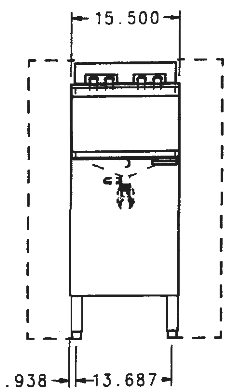
FREE STANDING ELECTRIC FRYERS

IMPORTANT:

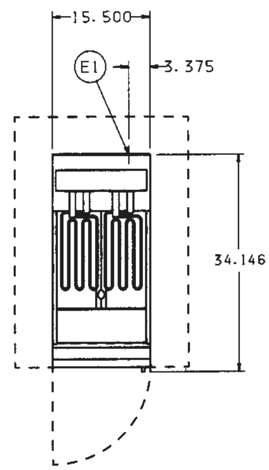
1. An adequate ventilation system required for commercial cooking equipment. Information may be obtained by writing to the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269. When writing refer to NFPA No. 96.
2. All models require a 6" clearance at both sides and rear adjacent to combustible construction.
3. This appliance is manufactured for commercial installation only and not intended for domestic/household installation.
4. All models require a 16" (407 mm) minimum clearance to adjacent open top burner units.
5. This appliance is manufactured for commercial installation only and is not intended for home use.

SERVICE CONNECTIONS:

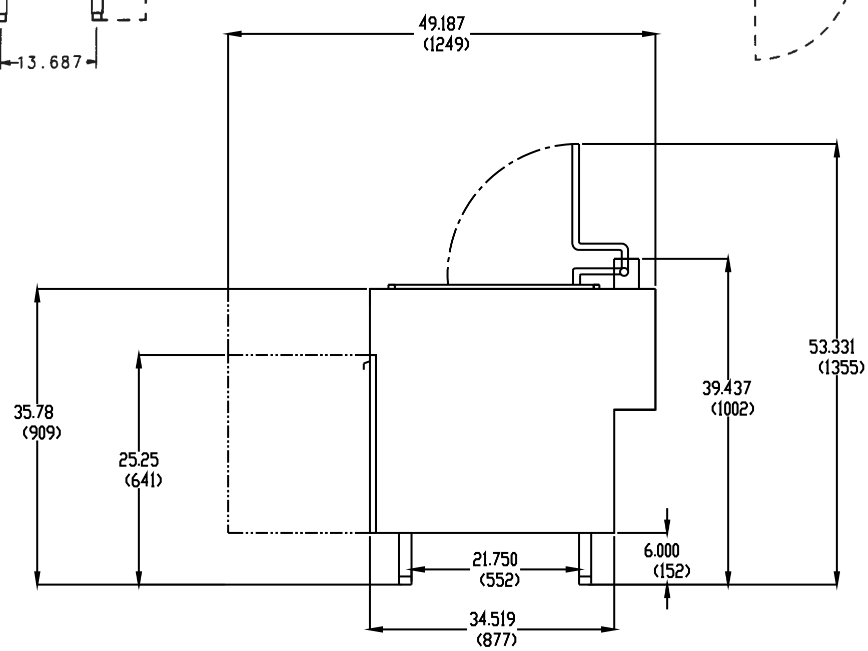
E1 Electrical Connection
120 volt, 60 Hz, 1 phase electrical connection (filter pump).



FRONT VIEW



TOP VIEW



SIDE VIEW

ELECTRICAL CHARACTERISTICS									
MODEL NO.	TOTAL KW CONN.	3 PH LOADING KW PER PHASE		NOMINAL AMPS PER LINE WIRE 3 PHASE					
		208	480V	208 VOLT			480 VOLT		
		X-Y	X-Z	X	Y	Z	X	Y	Z
1ER50	17	5.6	5.6	47	47	47	20	20	20

NOTE: In line with its policy to continually improve its products, Vulcan-Hart Company reserves the right to change materials and specifications without notice.

VULCAN-HART COMPANY, P.O. BOX 696, LOUISVILLE, KY 40201, TEL. 1-800-814-2028
502-778-2791 QUOTE & ORDER FAX: 1-800-444-0602

C Results Reporting Sheets

Manufacturer: Vulcan
Model: ER50D
Serial Number: 48-1601488
Date: Feb 2008

Test Fryer and Elements.

Description of operational characteristics: The Vulcan ER50D is a 14-inch electric fryer with a rated input of 17.0 kW. The fryer uses ribbon elements to transfer heat into the frying medium and features an insulated frypot. The fryer has an oil capacity of 50lbs and is operated with solid-state controls.

Apparatus.

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

Deviations: The French fries used for heavy and light-load energy efficiency tests had an initial moisture content of 71.1%

Energy Input Rate.

Voltage (V)	208
Name Plate (kW)	14.0
Measured (kW)	14.7
Percent Difference between Measured and Rated (%)	4.76

Oil Capacity.

Rated (lb)	50.0
Measured (lb)	51.2

Results Reporting Sheets

Preheat Energy and Time.

Voltage (V)	208
Starting Temperature (°F)	78.1
Energy Consumption (kWh)	1.76
Duration (min)	6.30
Preheat Rate (°F/min)	41.6

Idle Energy Rate.

Voltage (V)	208
Idle Energy Rate (kW)	0.63

Heavy-Load Cooking-Energy Efficiency and Cooking Energy Rate.

Voltage (V)	208
Load Size (lb)	3.0
French Fry Cook Time (min)	2.33
Average Recovery Time (sec)	< 10
Production Capacity (lb/h) [a]	71.9 ± 4.7
Energy to Food (Btu/lb)	587
Cooking Energy Rate (kW)	14.5
Energy per Pound of Food Cooked (Btu/lb)	689
Cooking-Energy Efficiency (%)[a]	85.3 ± 1.6

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

Results Reporting Sheets

Light-Load Cooking-Energy Efficiency and Cooking Energy Rate.

Voltage (V)	208
Load Size (lb)	0.75
French Fry Cook Time (min)	1.84
Average Recovery Time (sec)	< 10
Production Capacity (lb/h) [a]	23.0 ± 0.6
Energy to Food (Btu/lb)	583
Cooking Energy Rate (kW)	5.47
Energy per Pound of Food Cooked (Btu/lb)	813
Cooking-Energy Efficiency (%)[a]	71.8 ± 4.0

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

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 Fry Test Data.

	Repetition #1	Repetition #2	Repetition #3
Measured Values			
Test Voltage	208	208	208
Electrical Energy Consumption (Wh)	3,000	3,040	3,040
Total Appliance Energy (Btu)	10,329	10,376	10,376
Cook Time (min)	2.42	2.30	2.28
Total Test Time (min)	12.9	12.4	12.3
Weight Loss (%)	29.60	31.00	30.60
Initial Weight (lb)	15.000	15.000	15.000
Final Weight (lb)	10.565	10.355	10.405
Initial Moisture Content (%)	71.1	71.1	71.1
Final Moisture Content (%)	51.6	52.8	52.0
Initial Temperature (°F)	0	0	0
Final Temperature (°F)	212	212	212
Calculated Values			
Initial Weight of Water (lb)	10.665	10.665	10.665
Final Weight of Water (lb)	5.452	5.467	5.411
Sensible (Btu)	2,210	2,210	2,210
Latent – Heat of Fusion (Btu)	1,536	1,536	1,536
Latent – Heat of Vaporization (Btu)	5,057	5,042	5,096
Total Energy to Food (Btu)	8,803	8,788	8,842
Energy to Food (Btu/lb)	587	586	589
Total Energy to Fryer (Btu)	10,239	10,376	10,376
Energy to Fryer (Btu/lb)	683	692	692
Cooking-Energy Efficiency (%)	86.0	84.7	85.2
Cooking Energy Rate (kW)	13.9	14.8	14.8
Production Rate (lb/h)	69.7	72.8	73.1
Average Recovery Time (sec)	< 10	< 10	< 10

Cooking-Energy Efficiency Data

Table D-3. Light-Load Fry Test Data.

	Repetition #1	Repetition #2	Repetition #3
Measured Values			
Test Voltage	208	208	208
Electrical Energy Consumption (Wh)	920	880	880
Total Appliance Energy (Btu)	3,140	3,003	3,003
Cook Time (min)	1.87	1.83	1.83
Total Test Time (min)	9.92	9.75	9.75
Weight Loss (%)	30.50	30.10	30.10
Initial Weight (lb)	3.750	3.750	3.750
Final Weight (lb)	2.608	2.623	2.621
Initial Moisture Content (%)	71.1	71.1	71.1
Final Moisture Content (%)	52.5	52.9	52.5
Initial Temperature (°F)	0	0	0
Final Temperature (°F)	212	212	212
Calculated Values			
Initial Weight of Water (lb)	2.666	2.666	2.666
Final Weight of Water (lb)	1.369	1.388	1.376
Sensible (Btu)	553	553	553
Latent – Heat of Fusion (Btu)	384	384	384
Latent – Heat of Vaporization (Btu)	1,258	1,240	1,251
Total Energy to Food (Btu)	2,195	2,177	2,188
Energy to Food (Btu/lb)	585	581	583
Total Energy to Fryer (Btu)	3,140	3,003	3,003
Energy to Fryer (Btu/lb)	837	801	801
Cooking-Energy Efficiency (%)	69.9	72.5	72.9
Cooking Energy Rate (kW)	5.56	5.42	5.42
Production Rate (lb/h)	22.7	23.1	23.1
Average Recovery Time (sec)	< 10	< 10	< 10

Cooking-Energy Efficiency Data

Table D-3. Cooking-Energy Efficiency and Production Capacity Statistics.

	Cooking-Energy Efficiency (%) [a]		Production Capacity
	Heavy-Load	Light Load	(lbs/h) [a]
Replicate #1	86.0	69.9	69.7
Replicate #2	84.7	72.5	72.8
Replicate #3	85.2	72.9	73.1
Average	85.3	71.8	71.9
Standard Deviation	0.66	1.63	1.88
Absolute Uncertainty	1.64	4.04	4.66
Percent Uncertainty	1.92	5.63	6.48

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

E Energy Cost Model

Procedure for Calculating the Energy Consumption of a Fryer Based on Reported Test Results

Appliance test results are useful not only for benchmarking appliance performance, but also for estimating appliance energy consumption. The following procedure is a guideline for estimating fryer energy consumption based on data obtained from applying the appropriate test method.

The intent of this Appendix is to present a standard method for estimating fryer energy consumption based on ASTM performance test results. The examples contained herein are for information only and should not be considered an absolute. To obtain an accurate estimate of energy consumption for a particular operation, parameters specific to that operation should be used (e.g., operating time, and amount of food cooked).

The calculation will proceed as follows: First, determine the appliance operating time and total number of preheats. Then estimate the quantity of food cooked and establish the breakdown between heavy- (two 1½-lb baskets) and light- (one ¾-lb basket) loads. For example, a fryer operating for 12 hours a day with one preheat cooked 100 pounds of food: 70% of the food was cooked under heavy-load conditions and 30% was cooked under light-load conditions. Calculate the energy due to cooking at heavy- and light-load cooking rates, and then calculate the idle energy consumption. The total daily energy is the sum of these components plus the preheat energy. For simplicity, it is assumed that subsequent preheats require the same time and energy as the first preheat of the day.

The application of the test method to an electric fryer yielded the following results:

Energy Cost Model

Table E-1: Electric Fryer Performance Parameters.

Test	Result
Preheat Time (min)	6.30
Preheat Energy (kWh)	1.76
Idle Energy Rate (kW)	0.63
Heavy-Load Cooking Energy Rate (kW)	14.5
Light-Load Cooking-Energy Rate (kW)	5.47
Heavy-Load Production Capacity (lb/h)	71.9
Light-Load Production Rate (lb/h)	23.0

***Step 1*—The operation being modeled has the following parameters.**

Table E-2: Fryers Operation Assumptions.

Operating Time (h)	12
Number of Preheats	1
Percentage of Food Cooked Under Heavy-Load Conditions	70% (× 100 lb = 70 lb)
Percentage of Food Cooked Under Light-Load Conditions	30% (× 100 lb = 30 lb)

***Step 2*—Calculate the total heavy-load energy.**

The total time cooking heavy-loads is as follows:

$$t_h = \frac{\%_h \times W}{PC},$$

$$t_h = \frac{70\% \times 100\ lb}{71.9\ lb/h},$$

$$t_h = 0.97\ h$$

The total heavy-load energy consumption is then calculated as follows:

$$E_{elec,h} = q_{elec,h} \times t_h,$$

$$E_{elec,h} = 14.5\ kW \times 0.97\ h,$$

$$E_{elec,h} = 14.1\ kWh$$

***Step 3*—Calculate the total light-load energy.**

The total time cooking light-loads is as follows:

$$t_l = \frac{\%_l \times W}{PR_l},$$

$$t_l = \frac{30\% \times 100\ lb}{23.0\ lb/h},$$

$$t_l = 1.30\ h$$

The total light-load energy consumption is then calculated as follows:

$$E_{elec,l} = q_{elec,l} \times t_l,$$

$$E_{elec,l} = 5.47\ kW \times 1.30\ h$$

$$E_{elec,l} = 7.11\ kWh$$

***Step 3*—Calculate the total idle time and energy consumption.**

The total idle time is determined as follows:

$$t_i = t_{on} - t_h - t_l - \frac{n_p \times t_p}{60},$$

$$t_i = 12.0\ h - 0.97h - 1.30h - \frac{1\ preheat \times 6.30\ min}{60\ min/h}$$

$$t_i = 9.62\ h$$

The idle energy consumption is then calculated as follows:

$$E_{elec,i} = q_{elec,i} \times t_i,$$

$$E_{elec,i} = 0.63\ kW \times 9.62\ h$$

$$E_{elec,i} = 6.06\ kWh$$

***Step 4*—The total daily energy consumption is calculated as follows:**

$$E_{elec,daily} = E_{elec,h} + E_{elec,l} + E_{elec,i} + n_p \times E_{elec,p},$$

$$E_{elec,daily} = 14.1\ kWh + 7.11\ kWh + 6.06\ kWh + 1 \times 1.76\ kWh$$

$$E_{elec,daily} = 29.0\ kWh/day$$

Step 5—Calculate the average demand as follows:

$$q_{avg} = \frac{E_{elec,\, daily}}{t_{on}} \,,$$

$$q_{avg} = \frac{29.0\ kWh}{12.0\ h} \,,$$

$$q_{avg} = 2.42\ kW$$

Step 6—The annual energy cost is calculated as follows:

$$Cost_{annual} = E_{elec,daily} \times R_{elec} \times Days$$

$$Cost_{snnual} = 29.0\ kWh/day \times 0.10\ \$/kWh \times 365\ days/year$$

$$Cost_{annual} = 1{,}059\ \$/year$$