Pitco SSH55 Gas Fryer Performance Tests

Application of ASTM Standard
Test Method F 1361-05

FSTC Report 5011.06.17

Food Service Technology Center
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Prepared by:
David Cowen
David Zabrowski
Fisher-Nickel, Inc.

Contributors:
Scott Miner
Fisher-Nickel Inc.

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

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Contents

List of Figures and Tables

Figures

Tables

Executive Summary

Figure ES-1.
Pitco SSH55 Fryer.

Pitco's SSH55 gas fryer features four patented high efficiency atmospheric burners with a combined rated input of 80,000 Btu/h. Standard equipment includes Down Draft Protection (DDP) and the industry's first Self Cleaning Burner System (SCB). An optional programmable cooking computer controls the input to the fryer and provides for a more consistent product. Figure ES-1 illustrates the SSH55 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 two different loading scenarios (heavy—3 pounds per load and light—¾ pound per load). The extraneous medium loads (1.5 pounds per load) were removed from the revised 2005 ASTM 1361 test procedure.[1] The SSH55's heavy-load cook time was 2.20 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.

[1] American Society for Testing and Materials. 2005. *Standard Test Method for the Performance of Open, Deep Fat Fryers.* ASTM Designation F 1361-05, in *Annual Book of ASTM Standards,* West Conshohocken, PA.

Cooking-energy efficiency is therefore defined by the following relationship:

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

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)	80,000
Measured Energy Input Rate (Btu/h)	80,983
Preheat Time to 350°F (min)	9.51
Preheat Energy to 350°F (Btu)	11,138
Idle Energy Rate @ 350°F (Btu/h)	8,140
Heavy-Load Cooking-Energy Efficiency (%)[a]	55.0 ± 1.1
Light-Load Cooking-Energy Efficiency (%)[a]	39.3 ± 3.1
Production Capacity (lb/h)[a]	71.8 ± 0.9
Average Frying Recovery Time (sec)[b]	18.6

[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.

During heavy-load testing Pitco's SSH55 gas fryer demonstrated a production capacity of 71.8 pounds of French fries per hour, while achieving a cooking-energy efficiency of 55.0%. The SSH55 required 2.20 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 18.6-seconds.

Figure ES-2 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.

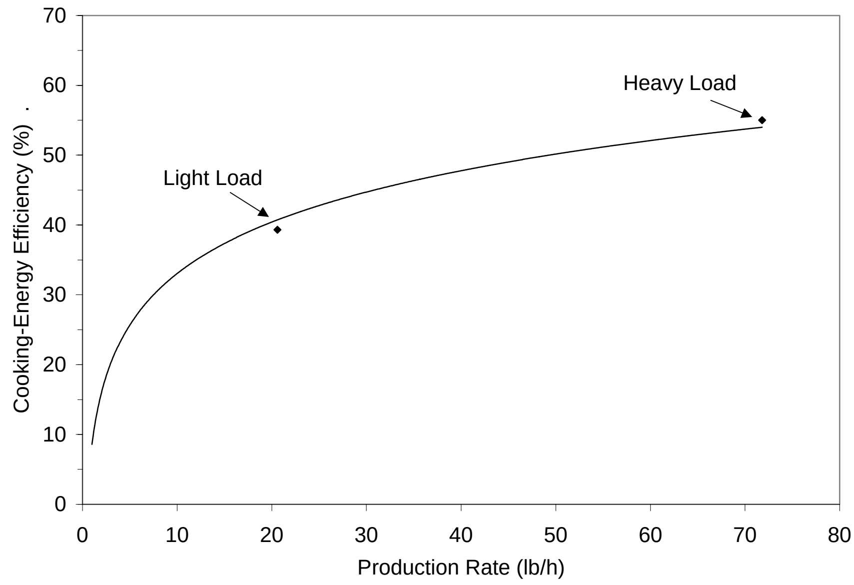

Figure ES-2.
Fryer part-load cooking-energy efficiency.

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

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 18,700 Btu/h, 37,200 Btu/h, and 55,800 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 energy consumption rate for this fryer would be 23,300 Btu/h.

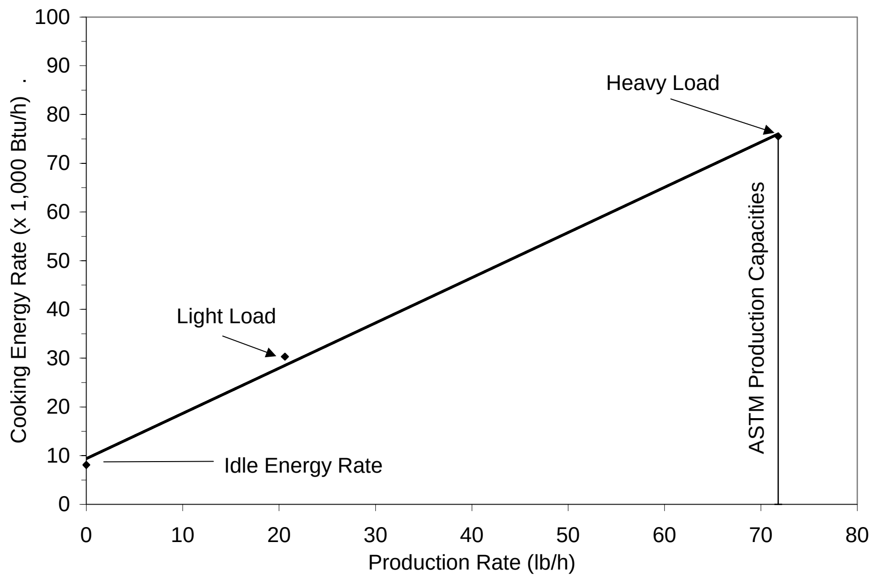

Figure ES-3.
Fryer cooking energy consumption profile.

Note: Light-load = ¾ pounds/load; Heavy-load = 3 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. 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. The estimated operational cost of the SSH55 gas fryer is $749 per year. 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.[a]

Preheat Energy (kBtu/day)	11.1
Idle Energy (kBtu/day)	76.6
Cooking Energy (kBtu/day)	117.5
Annual Energy (kBtu/year)	74,905
Annual Cost ($/year)[b]	749

[a] Cost Model was based on the fryer cooking 100 lbs. of food over a 12-hour day, 365 days per year.

[b] Fryer energy costs are based on $1.00/therm = 100,000 Btu.

Pitco's SSH55 gas fryer demonstrated short cook times and rapid oil temperature recovery during cooking. This type of performance will provide a food service operator with a workhorse fryer that can handle high volume, while its 55.0% cooking-energy efficiency securely places it among the top performing gas 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.[3-22] 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.

Pitco's SSH55 features a stainless steel frypot and backsplash design with patented self-cleaning high efficiency. An optional programmable cooking computer controls product cook times and an integrated melt cycle, which prevents solid frying medium from scorching during preheat.

This report presents the results of applying the ASTM test method to the Pitco SSH55 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 Pitco's SSH55, 14-inch gas fryer at an input rating of 80,000 Btu/h 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 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

Pitco's SSH55, 14-inch gas fryer has an input rating of 80,000 Btu/h. The fry pot is of stainless steel construction with heat transfer tubes running from front to back submerged in the frying medium (See figure 1-1). The fryer features Pitco's patented high efficiency self-cleaning Solstice Supreme burners. The tuned atmospheric burners allow the fryer to operate without the need for a blower or forced induction. The SSH55 also features down draft protection, a safety feature that protects against down drafts inside the flue.

An optional cooking computer allows individualized programming for multiple food products and incorporates a melt cycle to reduce the chances of scorching the fryer medium during preheat.

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

Figure 1-1.
Pitco SSH55 frypot.

Table 1-1. Appliance Specifications.

Manufacturer	Pitco
Model	SSH55
Generic Appliance Type	Open Deep Fat Fryer
Rated Input	80,000 Btu/h
Frying Area	14" x 14"
Oil Capacity	50 lb
Controls	Programmable cooking computer
Construction	Stainless Steel
Standard Equipment	Self-cleaning burners (SCB) and down draft protection (DDP)

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

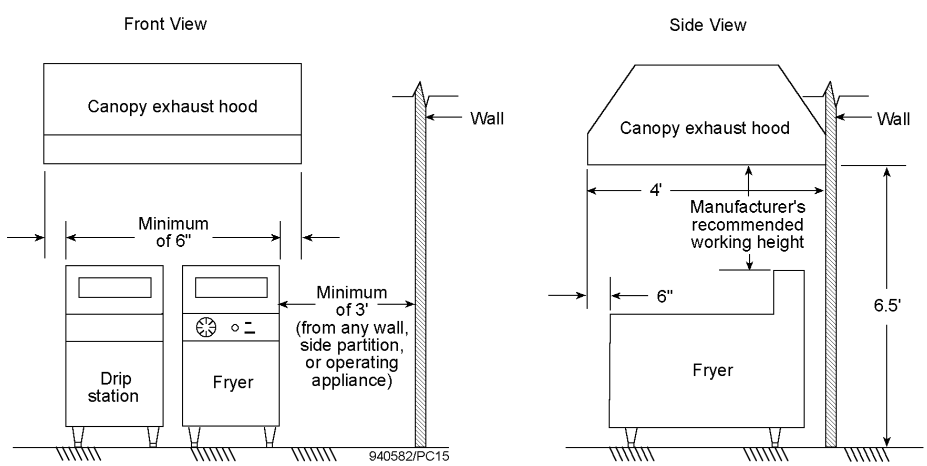

Figure 2-1.
Equipment configuration.

temperature. The cold zone temperature was measured toward the rear of the frypot, 1/8-inch from the bottom of the pot. Figure 2-2 is a graphic representation of where the thermocouples are located and do not represent their exact location during the testing of this fryer.

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 Cutler-Hammer calorimeter was used 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.

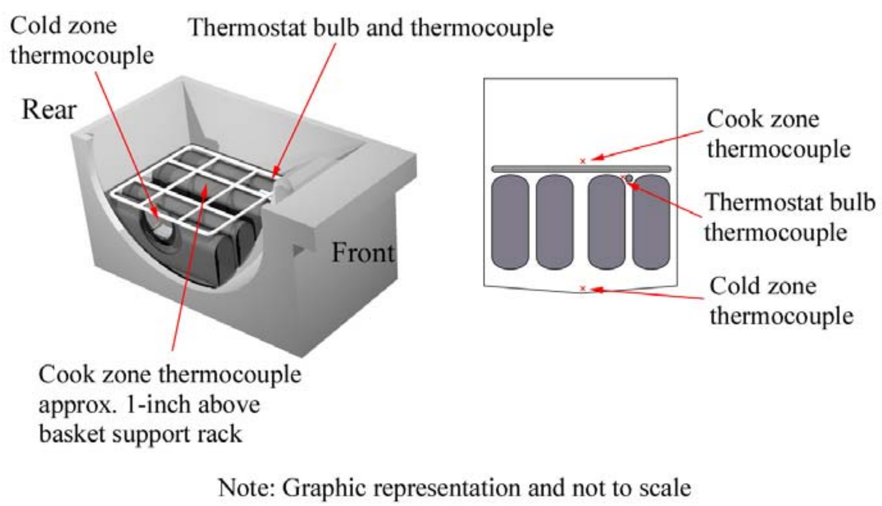

Figure 2-2. Thermocouple placement for testing.

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 firing (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. In the 2005 revision of ASTM F1361[1], the 1½-pound (medium-load) French fry loads were deemed extraneous and removed from the test procedure to simplify and reduce the cost of testing.

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; 70% under heavy-load (two 1.5 lb baskets) conditions with the remaining 30% under light-load (one 0.75 lb basket) conditions. 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. The cost model assumptions are listed in Table 2-1.

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

Table 2-1: Fryers Operation Assumptions.

Operating Time	12 h
Number of Preheats	1 preheat
Total Amount of Food Cooked	100 lb
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)

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 80,983 Btu/h (a difference of 1.23% 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. Pitco’s cooking computer has an integrated melt cycle to prevent scorching of solid shortening, but this feature was disabled to accommodate the liquid shortening specified by the ASTM test procedure. Pitco’s SSH55 fryer was ready to cook in 9.51 minutes, while consuming 11,138 Btu during the preheat. Figure 3-1 shows the fryer's preheat characteristics.

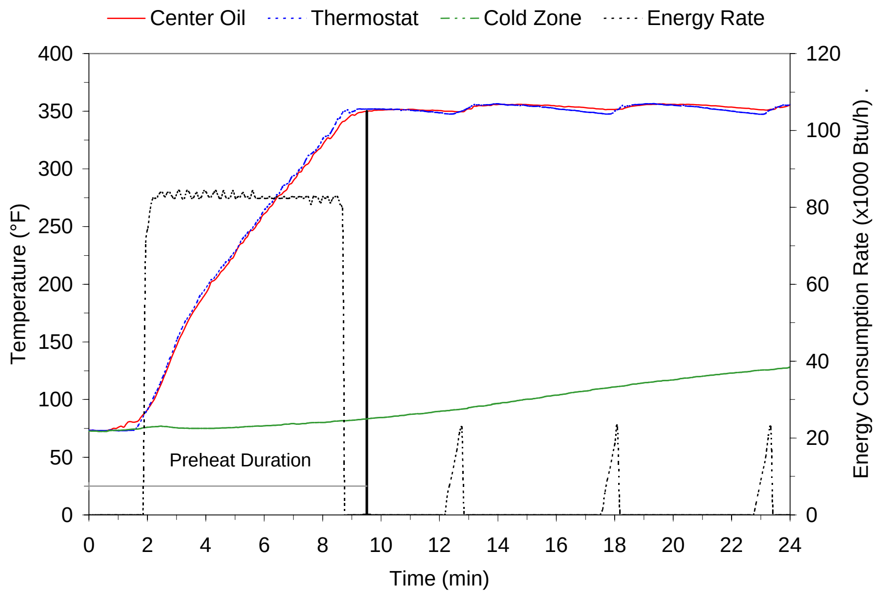

Figure 3-1.
Pitco SSH55 preheat characteristics.

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 8,140 Btu/h.

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 (Btu/h)	80,000
Measured Energy Input Rate (Btu/h)	80,983
Percentage Difference (%)	1.23
Preheat	
Time to 350°F (min)	9.51
Energy Consumption (Btu)	11,138
Control Energy (Wh)	3.76
Preheat Rate to 350°F (°F/min)	29.1
Idle	
Idle Energy Rate (Btu/h)	8,140
Control Energy Rate (W)	8.80

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.

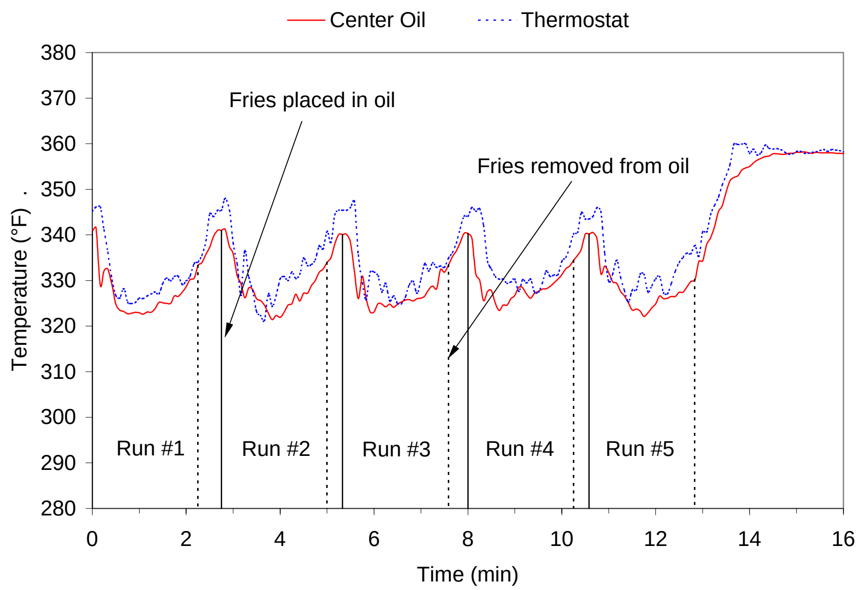

Figure 3-2.
Frying medium temperarture during a heavy-load test for the SSH55 fryer.

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 335°F. The heavy-load cook time for the fryer was 2.20 minutes, and the fryer was recovered within an average of 18.6 seconds. Figure 3-3 illustrates the temperature response of the Pitco 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).

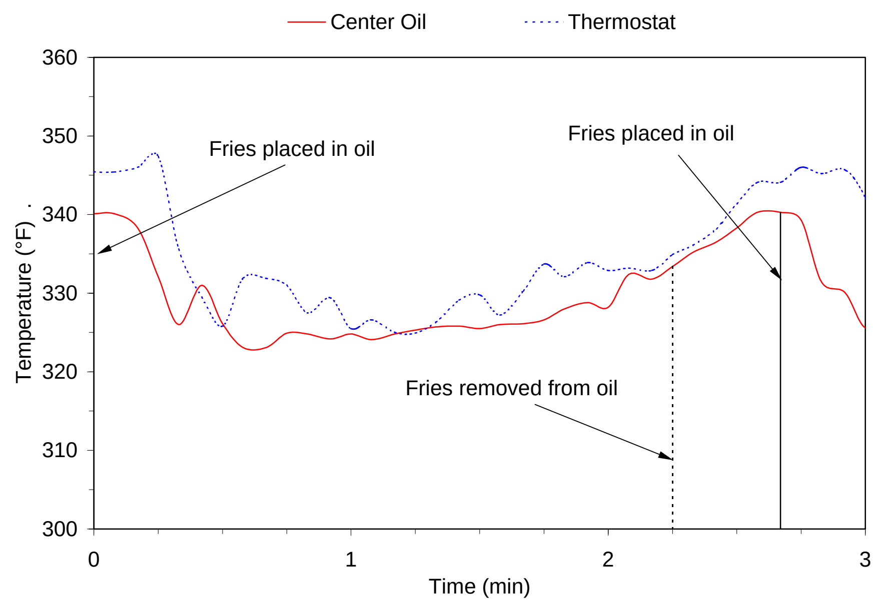

Figure 3-3.
Fryer cooking cycle temperature signature.

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, these part-load efficiencies 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 39.3% at a production rate of 20.6 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 54.5%, 55.3% and 55.3% yielding a maximum uncertainty of 1.1%. 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	¾
French Fry Cook Time (min)	2.20	2.00
Average Recovery Time (sec)	18.6	< 10
Production Rate (lb/h)[a]	71.8 ± 0.9	20.6 ± 0.2
Energy to Food (Btu/lb)	579	579
Cooking Energy Rate (Btu/h)	77,508	30,303
Control Energy Rate (W)	21.6	13.2
Energy per Pound of Food Cooked (Btu/lb)	1,053	1,474
Cooking-Energy Efficiency (%)[a]	55.0 ± 1.2	39.3 ± 3.1

[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.

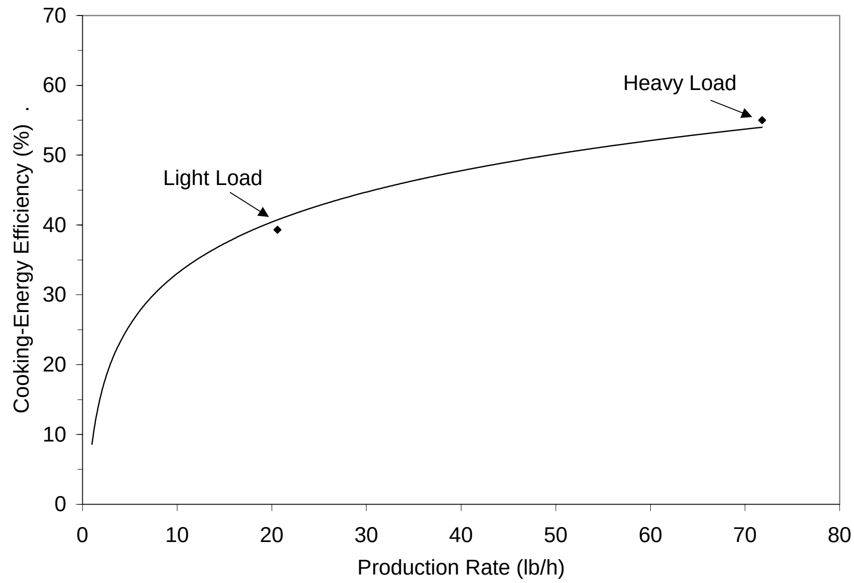

Figure 3-4.
Fryer part-load cooking-energy efficiency.

Note: Light-load = ¾ pounds/load; Heavy-load = 3 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 18,700 Btu/h, 37,200 Btu/h, and 55,800 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 energy consumption rate for this fryer would be 23,300 Btu/h.

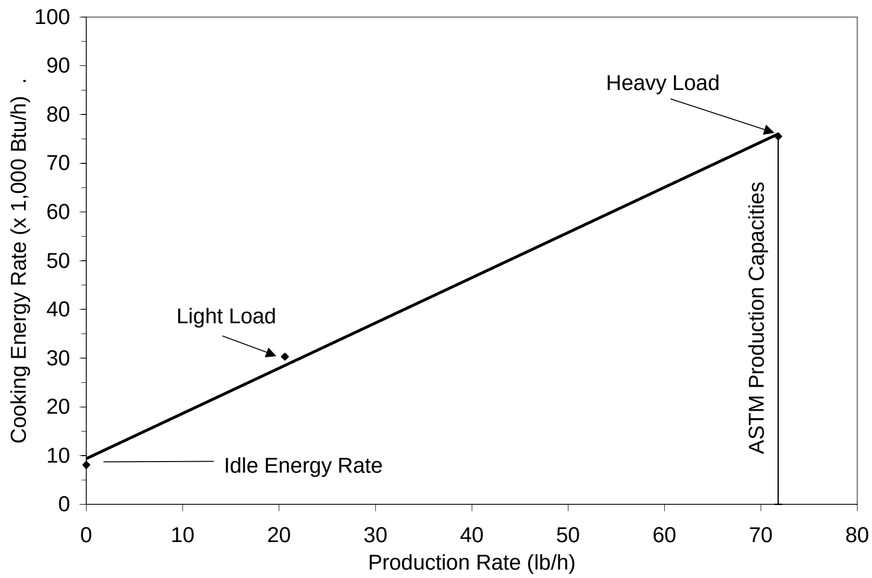

Figure 3-5.
Fryer cooking energy consumption profile.

Note: Light-load = ¾ pounds/load; Heavy-load = 3 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.[a]

Preheat Energy (kBtu/day)	11.1
Idle Energy (kBtu/day)	76.6
Cooking Energy (kBtu/day)	117.5
Annual Energy (kBtu/year)	74,905
Annual Cost ($/year)[b]	749

[a] Cost Model was based on the fryer cooking 100 lbs. of food over a 12-hour day, 365 days per year.

[b] Fryer energy costs are based on $1.00/therm = 100,000 Btu.

4 Conclusions

Pitco's Solstice Supreme, model SSH55, gas fryer exhibited solid performance under the rigorous conditions of the ASTM *Standard Test Method for the Performance of Open Deep Fat Fryers* (F1361-05). The SSH55's redesigned heat exchanger transfers heat to the frying medium more effectively than previous Pitco designs, giving the fryer faster cook times and higher production rates without compromising energy-efficiency.[4, 12, 13]

During heavy-load testing the SSH55 fryer was able to cook a 3-pound load of fries in a rapid 2.20 minutes. The cooking-energy efficiency was an impressive 55.0% for the heavy-loads with an equally impressive production capacity of 71.8 lb/h, an increase of 4.8 lb/h (6.7%) over the previous generation SGH50 gas fryer. [13]

During preheat, the Pitco SSH55 gas fryer was ready to cook in 9.51 minutes, while consuming 11,138 Btu. The fryer also demonstrated a very low idle energy rate (8,140 Btu/h), which translates to good part-load performance. The light-load cooking tests posted a cooking-energy efficiency of 39.3% with a production rate of 20.6 lb/h. Since most foodservice establishments operate at an average of 15 pounds per hour over a typical day, these performance figures are more representative of real world applications.

With the results obtained from the application of the laboratory test, the annual expenditures associated with its operation can be estimated. For this model, the fryer was used to cook 100 pounds of food over a 12-hour day, with one preheat per day, 365 days a year. At $1.00/therm, the Pitco SSH55 fryer would have an annual operating cost of $749 under this scenario.

Pitco's SSH55 atmospheric burner gas fryer exhibited fast cook times and a low energy use, giving operators a high production fryer that is also energy-efficient.

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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- 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 Pitco SSH55 fryer.

Table B-1. Appliance Specifications.

Manufacturer	Pitco
Model	SSH55
Generic Appliance Type	Open Deep Fat Fryer
Rated Input	80,000 Btu/h
Frying Area	14" x 14"
Oil Capacity	50 lb
Controls	Programmable cooking computer
Construction	Stainless Steel
Standard Equipment	Self-cleaning burners (SCB) and down draft protection (DDP)

Project______________________

Item No.______________________

Quantity______________________

Model SSH55, SSH55T and SSH75 Solstice Supreme Gas Fryer

SSH75 with optional Computer, Basket Lift and casters

SSH55

ENERGY STAR

** on some Models

HIGH EFFICIENCY SERIES OF GAS FRYERS

For Energy Saving High Production frying specify Pitco Model SSH55, SSH55T, SSH75 tube fired gas fryers with Solstice Supreme Burner Technology which provides very dependable atmospheric heat transfer and fuel saving Energy Star TM** performance without the need for complex power blowers. This patented atmospheric burner system with its long lasting alloy heat baffles reaches up to 70% thermal efficiency and delivers lower flue temperatures. New Self Clean Burner (patent pending) goes through a daily 30 second cleaning cycle to keep your burners tuned to operate in the most energy efficient manner. Ventilation troubles are virtually eliminated with the Down Draft Protection (patent pending) that safely monitors your fryer, making this a low maintenance, highly reliable fryer.

MODELS AVAILABLE

- ❑ ***SSH55*** ***(40-50 lbs, 80KBtu/hr, 14" x 14" fry area)***
- ❑ ***SSH55T*** ***(20-25 lbs, 40KBtu/hr, 7" x 14" fry area per side for this split vat fryer)***
- ❑ ***SSH75*** ***(75 lbs, 105KBtu/hr, 18" x 18" fry area)***

STANDARD FEATURES & ACCESSORIES

- Tank - stainless steel construction
- Cabinet - stainless front, door and sides
- Solstice Burner Technology, No blower or ceramics
- Self Cleaning Burner & Down Draft Protection
- Solid State T-Stat with melt cycle and boil out mode
- Matchless Ignition with DVI drain valve interlock
- Heavy duty 3/16" bottom door hinge
- 1 ¼" (3.2 cm) Full port drain valve for fast draining
- Separate Manual gas shutoffs, for front servicing
- Integrated flue deflector
- 9" (22.9 cm) adjustable legs, easier access to clean
- Tube rack, allows crumbs & debris into cool zone
- Removable basket hanger, requires no tools
- Drain Line Clean out rod
- Drain Extension
- Fryer cleaner sample packet
- Choice of basket options :
  - ❑ Twin Baskets
  - ❑ Full Basket

OPTIONS & ACCESSORIES (AT ADDITIONAL COST)

- ❑ Digital Controller
- ❑ I-12 Computer
- ❑ Backup thermostat (only on Digital and I-12 computer)
- ❑ Basket Lift (must be ordered with Digital Control or Computer)
  (To meet AGA/CGA/CSA specification, must be ordered with casters & installed with flexible gas hose w/restraining cable)
- ❑ Stainless Steel back (not available with basket lift)
- ❑ 9"(22.9 cm) adjustable,non-lock rear & front lock casters
- ❑ Flexible gas hose with disconnect and restraining cable
- ❑ Tank cover
- ❑ Triple Baskets
- ❑ Institutional Prison security package
- ❑ BNB Dump Station
- ❑ Filter System, see Supreme Filter spec sheet for details

CONTROLS

- Matchless Ignition automatically lights the pilot when the power is turned on and saves you money during off times.
- Solid State Thermostat with melt cycle and boil out mode.
  - *Optional: Digital Controller with displaying 2 product timer*
  - *Optional: I-12 Computer with 12 product timer and flex time*
- DVI drain valve interlock safety system turns the heat off preventing the oil from scorching and overheating.
- Integrated gas control safety valve controls gas flow.
- Temperature limit switch safely shuts off all heat if the upper temperature limit is exceeded.

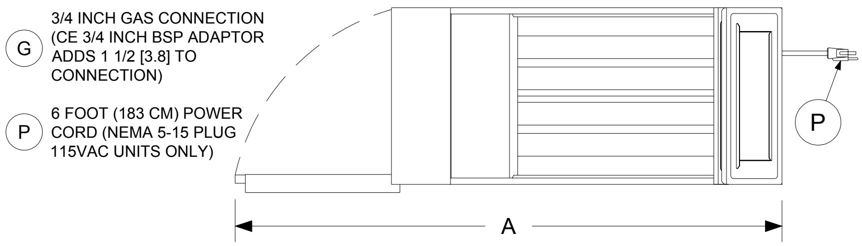
TYPICAL APPLICATIONS

High Volume restaurants or multi-store restaurant chains that require a Reliable, Highly Efficient EnergyStarTM** rating, High Production Fryer with low operational energy cost and lower annual maintenance and repair cost

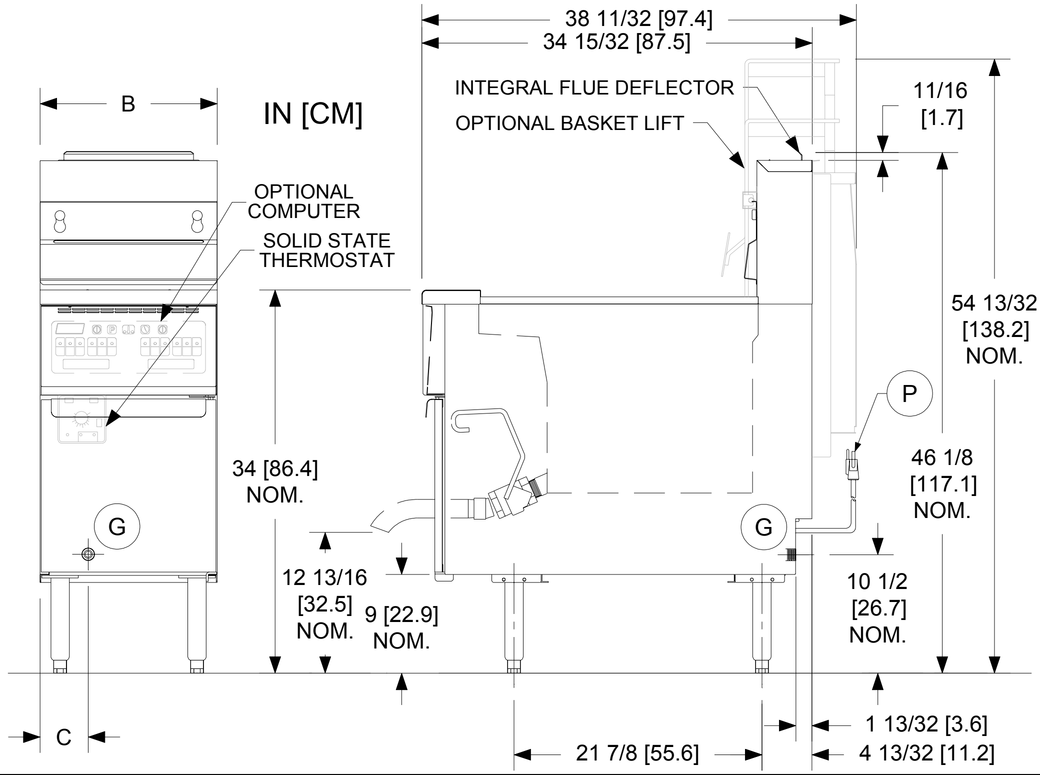
Patent Pending

Model SSH55, SSH55T and SSH75 Solstice Supreme Gas Fryer

Model SSH55, SSH55T and SSH75 Solstice Supreme Gas Fryer



	SSH55/55T	SSH75
A	48 11/32 [122.8]	52 11/32 [132.9]
B	15 5/8 [39.7]	19 5/8 [49.8]
C	4 1/4 [10.8]	6 1/4 [15.9]



INDIVIDUAL FRYER SPECIFICATIONS

Model	Frying Area	Cook Depth	Oil Capacity	Gas Input Rate / Hr
SSH55	14 x 14 in (35.6 x35.6cm)	3-1/4 - 5 in (8.3 -12.7cm)	40 - 50 Lbs (18 - 23 kg)	80,000 BTUs (23 kW) (84 MJ)
SSH55T per tank	7 x 14 in (35.6 x35.6cm)	3-1/4 - 5 in (8.3 -12.7cm)	20 - 25 Lbs (9 -11 kg)	40,000 BTUs (18 kW) (42 MJ)
SSH75	18 x 18 in (45.7 x 45.7 cm)	3-1/4 - 5 in (8.3 -12.7cm)	75 Lbs (34 kg)	105,000 BTUs (31 kW) (110 MJ)

FRYER SHIPPING INFORMATION (Approximate)

Model	Shipping Weight	Shipping Weight w B/L	Shipping Crate Size H x W x L	Shipping Cube
SSH55	208 Lbs (95 kg)	258 Lbs (117 kg)	58 x 22 x 44 in (147.3 x 55.8 x 111.7 cm)	32.5 ft^3. ($0.9m^3$)
SSH55T	230 Lbs (104 kg)	280 Lbs (127 kg)	58 x 22 x 44 in (147.3 x 55.8 x 111.7 cm)	32.5 ft^3. ($0.9m^3$)
SSH75	226 Lbs (103 kg)	276 Lbs (125 kg)	58 x 22 x 44 in (147.3 x 55.8 x 111.7 cm)	32.5 ft^3. ($0.9m^3$)

INSTALLATION INFORMATION

GAS SYSTEM REQUIREMENTS			ELECTRIC SYSTEM REQUIREMENTS (50/60 hz)			
Gas Type	Store Supply Pressure *	Burner Manifold Pressure	Amps	# of Cord	115V	208 / 220-240V
Natural	7 - 10" w.c.(17.4 mbars/ 1.7 kPa)	4" w.c. (10 mbars / 1 kPa)	Fryer	1	0.7	0.4
Propane	11 - 13" w.c.(27.4 mbars/ 2.7 kPa)	10" w.c. (25mbars/2.4 kPa)				

* Check plumbing / gas codes for proper gas supply line sizing to sustain burner pressure when all gas appliances are full on.

CLEARANCES (Do Not Curb Mount)

Front min.	Floor min.	Combustible material		Non-Combustible material		Fryer Flue Area
		Sides min.	Rear min.	Sides min.	Rear min.	
30" (76.2 cm)	6" (15.25 cm)	6" (15.2cm)	6" (15.2cm)	0"	0"	Do not block / restrict flue gases from flowing into hood or install vent hood drains over the flue.

SHORT FORM SPECIFICATION

Provide Pitco Model (SSH55,55T,75) tube fired high efficiency gas floor fryer with EnergyStar TM**rating. Fryer shall be xx-xx lbs oil capacity, xxx Kbtu/hr, xx" by xx" fry area, 304 SS peened tank, stainless front, door, sides. Blower Free atmospheric burner system with up to 70% thermal efficiency, self cleaning burners, down draft protection, matchless ignition, drain valve interlock, behind the door solid state t-stat with melt and boil mode, separate gas shut off, 3/4" npt rear gas connect, recessed cabinet back, 1-1/4" Full port drain, 3/16" bottom hinge, 9" adjustable legs, manual reset high limit. If supplied with casters: Casters with 1" min. adjustment and front toe locks. Provide options and accessories as follows:

C Results Reporting Sheets

Manufacturer: Pitco

Models: SSH55

Date: April 2006

Test Fryer and Burners.

Description of operational characteristics: Pitco's SSH55 gas fryer is rated at 80,000 Btu/h. The SSH55 fryer features four atmospheric burners running inside the heat transfer tubes from front to back, submerged in the frying medium. An optional cooking computer controls the burners with features such as a melt cycle and multiple programmable cook times.

Apparatus.

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

Deviations: None.

Energy Input Rate.

Rated (Btu/h)	80,000
Measured (Btu/h)	80,983
Percent Difference between Measured and Rated (%)	1.23

Fry Vat Capacity.

Oil Capacity (lbs)	50.1

Results Reporting Sheets

Preheat Energy and Time.

Starting Temperature (°F)	73.3
Energy Consumption (Btu)	11,138
Control Energy (Wh)	3.76
Duration (min)	9.51
Preheat Rate (°F/min)	29.1

Idle Energy Rate.

Idle Energy Rate (Btu/h)	8,140
Control Energy Rate (Wh)	8.80

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

Load Size (lb)	3.0
French Fry Cook Time (min)	2.20
Average Recovery Time (sec)	18.6
Production Capacity (lb/h) [a]	71.8 ± 0.9
Energy to Food (Btu/lb)	579
Cooking Energy Rate (Btu/h)	75,508
Control Energy Rate (W)	21.6
Energy per Pound of Food Cooked (Btu/lb)	1,053
Cooking-Energy Efficiency (%)[a]	55.0 ± 1.1

[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.

Load Size (lb)	¾
French Fry Cook Time (min)	2.00
Average Recovery Time (sec)	< 10
Production Rate (lb/h) [a]	20.6 ± 0.2
Energy to Food (Btu/lb)	579
Cooking Energy Rate (Btu/h)	30,303
Control Energy Rate (W)	13.2
Energy per Pound of Food Cooked (Btu/lb)	1,474
Cooking-Energy Efficiency (%)[a]	39.3 ± 3.1

[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			
Electrical Energy Consumption (Wh)	4.52	4.50	4.50
Gas Energy Consumption (Btu)	15,805	15,805	15,708
Cook Time (min)	2.20	2.20	2.20
Total Test Time (min)	12.6	12.5	12.5
Weight Loss (%)	29.60	30.10	29.60
Initial Weight (lb)	15.000	15.000	15.000
Final Weight (lb)	10.554	10.489	10.556
Initial Moisture Content (%)	69.6	69.6	69.6
Final Moisture Content (%)	50.9	50.1	50.3
Initial Temperature (°F)	0	0	0
Final Temperature (°F)	212	212	212
Calculated Values			
Initial Weight of Water (lb)	10.440	10.440	10.440
Final Weight of Water (lb)	5.372	5.254	5.310
Sensible (Btu)	2,210	2,210	2,210
Latent – Heat of Fusion (Btu)	1,503	1,503	1,503
Latent – Heat of Vaporization (Btu)	4,916	5,029	4,976
Total Energy to Food (Btu)	8,629	8,742	8,689
Energy to Food (Btu/lb)	575	583	579
Total Energy to Fryer (Btu)	15,822	15,820	15,723
Energy to Fryer (Btu/lb)	1,055	1,055	1,048
Cooking-Energy Efficiency (%)	54.5	55.3	55.3
Cooking Energy Rate (Btu/h)	75,262	75,864	75,398
Control Energy Rate (W)	21.5	21.6	21.6
Production Rate (lb/h)	71.4	72.0	72.0
Average Recovery Time (sec)	19.2	18.0	18.0

Cooking-Energy Efficiency Data

Table D-3. Light Load Fry Test Data.

	Repetition #1	Repetition #2	Repetition #3
Measured Values			
Electrical Energy Consumption (Wh)	2.40	2.40	2.40
Gas Energy Consumption (Btu)	5,375	5,717	5,472
Cook Time (min)	2.00	2.00	2.00
Total Test Time (min)	11.0	10.9	10.9
Weight Loss (%)	30.60	30.40	30.60
Initial Weight (lb)	3.750	3.750	3.750
Final Weight (lb)	2.604	2.610	2.602
Initial Moisture Content (%)	69.2	69.2	69.2
Final Moisture Content (%)	50.7	50.4	50.1
Initial Temperature (°F)	0	0	0
Final Temperature (°F)	212	212	212
Calculated Values			
Initial Weight of Water (lb)	2.595	2.595	2.595
Final Weight of Water (lb)	1.320	1.315	1.304
Sensible (Btu)	553	553	553
Latent – Heat of Fusion (Btu)	374	374	374
Latent – Heat of Vaporization (Btu)	1,237	1,242	1,252
Total Energy to Food (Btu)	2,164	2,169	2,179
Energy to Food (Btu/lb)	577	578	581
Total Energy to Fryer (Btu)	5,382	5,725	5,480
Energy to Fryer (Btu/lb)	1,435	1,527	1,461
Cooking-Energy Efficiency (%)	40.2	37.9	39.8
Cooking Energy Rate (Btu/h)	29,318	31,470	30,121
Control Energy Rate (W)	13.1	13.2	13.2
Production Rate (lb/h)	20.5	20.6	20.6
Average Recovery Time (sec)	< 10	< 10	< 10

Cooking-Energy Efficiency Data

Table D-4. Cooking-Energy Efficiency and Production Capacity Statistics.

	Cooking-Energy Efficiency (%) [a]		Production Capacity (lbs/h) [a]
	Heavy-Load	Light-Load	
Replicate #1	54.5	40.2	71.4
Replicate #2	55.3	37.9	72.0
Replicate #3	55.3	39.8	72.0
Average	55.0	39.3	71.8
Standard Deviation	0.46	1.23	0.46
Absolute Uncertainty	1.14	3.05	1.14
Percent Uncertainty	2.07	7.76	2.07

[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 under heavy- and light-loads).

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 a gas fryer yielded the following results:

Energy Cost Model

Table E-1: Gas Fryer Performance Parameters.

Test	Result
Preheat Time (min)	9.51
Preheat Energy (Btu)	11,138
Idle Energy Rate (Btu/h)	8,140
Heavy-Load Cooking Energy Rate (Btu/h)	75,508
Light-Load Cooking Energy Rate (Btu/h)	30,303
Production Capacity (lb/h)	71.8
Light-Load Production Rate (lb/h)	20.6

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

Table E-2: Fryers Operation Assumptions.

Operating Time	12 h
Number of Preheats	1 preheat
Total Amount of Food Cooked	100 lb
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:

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

$$t_h = \frac{70\% \times 100\ lb}{71.8\ lb/h},$$

$$t_h = 0.97\ h$$

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

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

$$E_{gas,h} = 75{,}508 \text{ Btu/h} \times 0.97 \text{ h},$$

$$E_{gas,h} = 73{,}243 \text{ Btu}$$

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

The total time cooking light-loads is as follows:

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

$$t_l = \frac{30\% \times 100 \text{ lb}}{20.6 \text{ lb/h}},$$

$$t_l = 1.46 \text{ h}$$

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

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

$$E_{gas,l} = 30{,}303 \text{ Btu/h} \times 1.46 \text{ h}$$

$$E_{gas,l} = 44{,}242 \text{ Btu}$$

***Step 4*—Calculate the total idle time and energy consumption.**

The total idle time is determined as follows:

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

$$t_i = 12.0 \text{ h} - 0.97 \text{ h} - 1.46 \text{ h} - \frac{1 \text{ preheat} \times 9.51 \text{ min}}{60 \text{ min/h}}$$

$$t_i = 9.41 \text{ h}$$

The idle energy consumption is then calculated as follows:

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

$E_{gas,i} = 8{,}140\ Btu/h \times 9.41\ h$

$E_{gas,i} = 76{,}597\ Btu$

***Step 5*—The total daily energy consumption is calculated as follows:**

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

$E_{gas,daily} = 73{,}243\ Btu + 44{,}242\ Btu + 76{,}597\ Btu + 1 \times 11{,}138\ Btu$

$E_{gas,daily} = 205{,}220\ Btu/day = 2.052\ therms/day$

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

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

$Cost_{snnual} = 2.052\ therms/day \times 1.00\ \$/therm \times 365\ days/year$

$Cost_{annual} = 749\ \$/year$