Appliance Test Report SCGAT162812A

Royal REEF-35
Open Deep Fat Fryer Performance Test
Revision 0

SoCalGas
A Sempra Energy utility

Southern California Gas Company
Customer Programs Department

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Revision History

Revision No.	Date	Description	Author
0	January 31, 2017	Initial Release	Jose Urzua, Ahmed Sallam

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Executive Summary

The "Royal Range" Model REEF-35, a full-size Open Deep Fat Fryer (Figure 1), was evaluated for energy performance at the Southern California Gas Company's (SCG) Commercial Food Service Testing Laboratory (FSTL). The fryer was tested according to the specifications of The American Society for Testing and Materials' (ASTM) standard test method F 1361-07. To be considered energy efficient, a fryer must achieve at least ***50% efficiency*** for the heavy-load cooking-energy efficiency test and an idle rate **less than 9,000 Btu/hr.** The Royal REEF-35 fryer **passed** both requirements. The test results for the Royal REEF-35 (S/N 348416) are as follows:

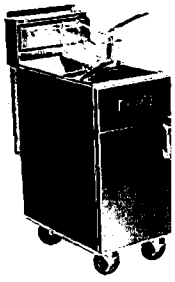

Figure 1
"Royal"
REEF-35
Open Deep Fat Fryer

Table ES-1. Summary of ASTM Open Deep Fat Fryer Performance Results

Heavy-load cooking-energy efficiency (%)	**54.4**
Rated Energy Input Rate (Btu/h)	72,000
Measured Gas Energy Input Rate (Btu/h)	71,689
Preheat Time to 340°F (min)	9.34
Preheat Energy to 340°F (Btu)	10,592
Idle Energy Rate (*natural gas fuel*) at 350°F (Btu/h)	**8,764**
Idle Energy Rate (*combined gas & electric*) at 350°F (Btu/h)	N/A
Pilot Energy Rate (Btu/h)	836
Production Rate (lb/h)	60

The heavy-load cooking-energy efficiency test consisted of frying fresh ¼ in. blue ribbon shoestring potatoes per full-size fryer with two baskets. As specified by the ASTM test method, cooking-energy efficiency is a measure of how much of the energy that an appliance consumes is actually delivered to the food product during the cooking process. Cooking-energy efficiency is therefore defined by the following relationship:

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

Mission Statement - Commercial Food Service Equipment Testing

Recent advances in equipment design have produced commercial foodservice equipment that operates more efficiently, quickly, safely and conveniently. An energy efficient commercial equipment reduces energy consumption primarily through advanced technology and design.

The purpose of Southern California Gas Company's Energy Efficiency Commercial Food Service Equipment Testing Program is to provide energy efficiency measurement for cost effectiveness modeling in order to establish energy efficiency standards and ratings for commercial food service equipment. This measurement data is then utilized and integrated with typical equipment usage profiles for California Utility Customers participating in the Food Service Equipment Rebate Program.

The equipment performance is determined by applying the American Society for Testing and Materials (ASTM) standard test method for performance. The ASTM standard test method is considered the industry standard for quantifying the efficiency and performance for cooking equipment.

Scope

The scope of this test is to evaluate the performance of the "Royal" REEF-35 gas-fired Open Deep Fat Fryer, by using ASTM F 1361-07 "*Standard Test Method for Performance of Open Deep Fat Fryers*" for the test procedure and evaluation criteria.

In order to evaluate the fryer's energy consumption and cooking performance, the following were performed:

- Verify energy rating
- Verify thermostat calibration
- Determine energy input rate, preheat energy consumption and time
- Determine pilot energy consumption
- Determine cooking rate uncertainty
- Determine production rate uncertainty
- Report findings

Appliance and test overview

The "Royal" REEF-35 is a natural gas-fired, full size fryer rated at 72,000 Btu/h. The fryer is equipped with one swing-out door, with a surrounding stainless steel outer case. The fryer's cavity can accommodate up to two (2) steel-wired baskets spaced evenly. The fryer's controls include on/off knob along with a pilot setting for ignition. There is also a temperature knob used to adjust the frying medium temperature. Labels and controls are located inside the swing-out door in order to adjust to a desired setting.

The test consisted of taking fresh ¼ in. blue ribbon shoestring potatoes with an initial temperature of -5 ± 5°F and cooking them until their weight loss equals 30 ± 1%. Weight measurements were taken before and after cooking to determine cooking energy efficiency, production rate, and total weight loss.

The gas volume, pressure and temperature were monitored and recorded as well as the ambient air temperature and pressure. Type K thermocouples were used to monitor the ambient, fryer medium and cold zone temperature. Electrical power measurements were not monitored and recorded. A National Instruments data acquisition system was used to monitor and record all data. See section "Testing Equipment Inventory" for more detail regarding the testing equipment.

Comments, Deviations and Exceptions

Comments:

The heating values for each test were obtained from SCG's MCS Gas Analysis reports.

Deviations:

Testing procedures and results are limited to the heavy-load cooking scenario.

Exceptions:
None

Testing equipment inventory

Energy efficiency testing is conducted at SCG's Commercial Food Service Testing Laboratory located at the Energy Resource Center (ERC) in Downey California. The laboratory can provide utility services such as natural gas, water, electricity, sewer and fume exhaust for a variety of tests.

The testing equipment is mounted onto a mobile test bench providing the flexibility of movement within the test lab or for in the field use. The mobile test bench holds a data acquisition system, transducers, and various meters that allow to capture and record data. The cDAQ acquisition system delivers the capability to run seven hardware-timed channels simultaneously, provide four built in 32-bit counters/timers, and continually stream waveform measurements. The bench mounted pressure transducers monitor barometric ambient pressure and natural gas pressure before and after the gas meter. An analog gas meter is fitted with an electronic counter is used to measure gas consumption. See Tables TEI 1-1 for inventory and specifications on testing equipment.

Table TEI 1-1. Testing Equipment Inventory

ECN	Description	Manufacturer	Model	Date Calibrated	Calibration due date
100	Data Acquisition	National Instruments	cDAQ-9178	3/28/2016	3/28/2017
101a	Gas Meter	Elster	DTM 200A	9/28/2016	9/28/2017
102d	Barometric Pressure Transducer	Omega	EWS-BP-A	9/27/2016	9/27/2017
103c	Differential Pressure Transmitter	Dwyer	607-9	9/27/2016	9/27/2017
108	Bench scale	A&D	FG-60KAL	6/22/2016	6/22/2017
124p	Thermocouples	Omega	Type-K	3/1/2016	3/1/2017

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Performance of Open Deep Fat Fryer
RESULTS SUMMARY
ASTM F 1361-07 (10)

Manufacturer	Royal
Model	REEF-35
Date	1/25/17
Fryer serial number	348416

1. Appliance Type – Full-Size Open Deep Fat Fryer (10.1)

Fuel type:	Natural gas
Fryer rating:	72,000 Btu/h
Physical dimensions	
Size of fryer (in^3):	21,382
Size of fryer cavity (in^3):	2,021
Fryer medium volume:	35 lb

Controls:

All the fryer's controls lie on a panel just inside the single swing-out door. At the bottom of the panel resides a knob with an option of "On and Off" along with a Pilot setting. There is also a Temperature dial in order to adjust for desired setting.

Description of operational characteristics:

With the thermostat control dial set at approximately 350°F, the average temperature at the center of the fryer was determined to be *not in range.* The thermostat was readjusted to 340°F, which yielded a cavity temperature of 351.9°F within the limit of ± 5°F set forth in the ASTM F 1361-07 test method section 10.3.

2. Apparatus (9.0)

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

3. Thermostat Calibration (10.3)

As-Received:

Fryer temperature control setting (°F)	340
Fryer cavity temperature (°F)	351.9

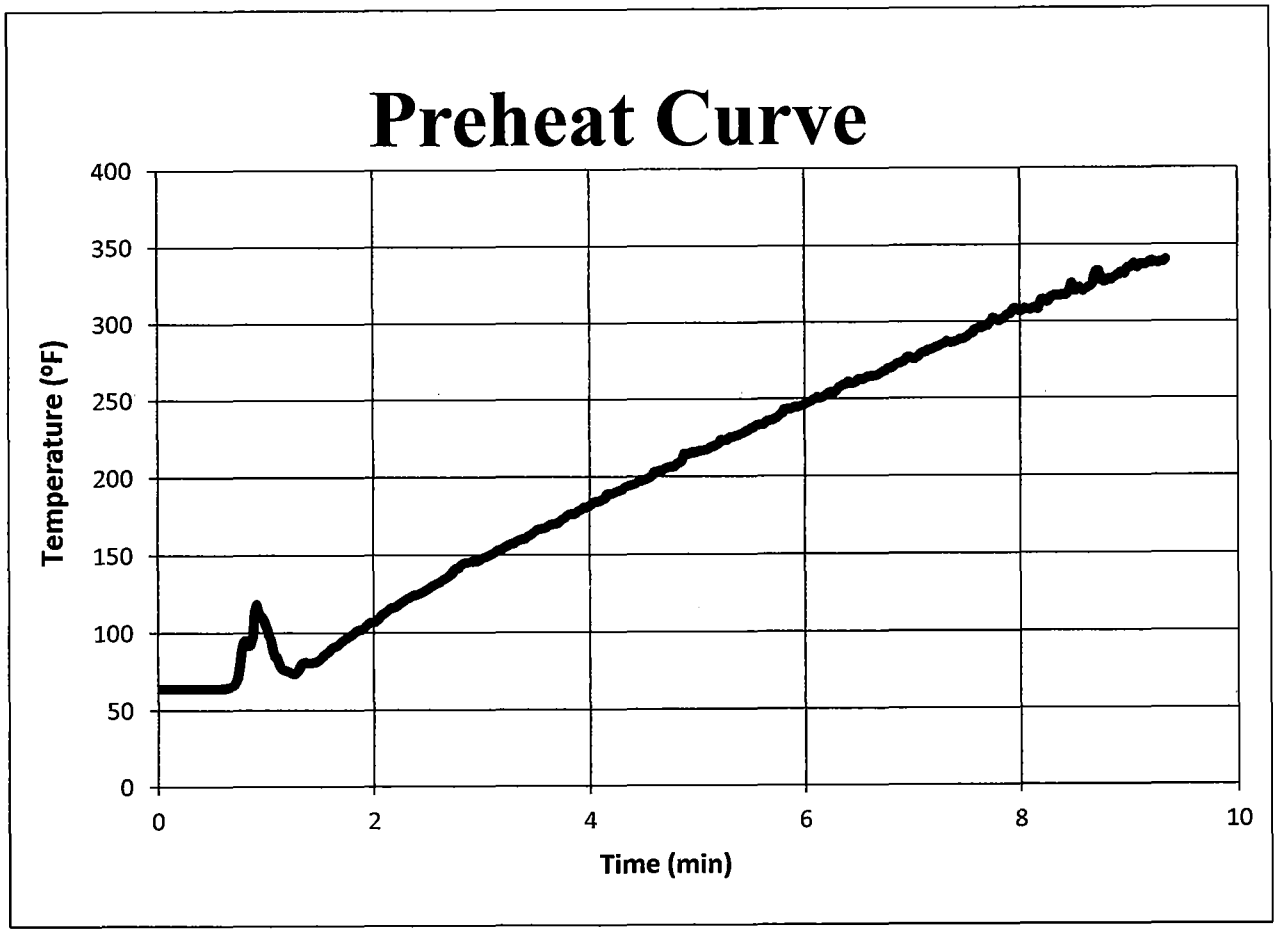
4. Energy Input Rate (10.2)

Test voltage (V)	N/A
Higher heating value of natural gas (Btu/ft^3)	1033
Measured gas input rate (Btu/h)	71,689
Rated (Btu/h)	72,000
Percent difference between measured and rated (%)	0.4

5a. Preheat Energy and Time (10.4)

Test Voltage (V)	N/A
Higher heating value of natural gas (Btu/ft^3)	1031
Starting temperature of fryer medium (°F)	64.0
Energy consumption of natural gas (Btu)	10,592
Duration (min)	9.34
Preheat rate (°F/min)	29.5

5b. Preheat Curve (10.4 - Continued)



6. Pilot Energy Rate (if applicable) (10.6)

See Comments, Deviations and Exceptions

Gas heating value (Btu/ft^3)	1035
Pilot energy rate (Btu/h)	836

7. Idle Energy Rate (10.5)

Test Voltage (V)	N/A
Higher heating value of natural gas (Btu/ft^3)	1033
Idle energy rate at 350°F – *natural gas only* (Btu/h)	8,764

Idle energy rate at 350°F – *gas & electric* (Btu/h)	N/A
Electric energy rate at 350°F (kW)	N/A

8. Cooking Energy Efficiency, Cooking Energy Rate, and Production Rate (10.10) [1]

Heavy-Load:

Test voltage (V)	N/A
Higher heating value of natural gas (Btu/ft^3)	1032
Cooking time (min)	15.00
Production rate (lb/h)	60
Energy to food (Btu)	9,212
Cooking energy rate (Btu/h)	16,942
Electric cooking energy rate (kW)	N/A
Energy per pound of food cooked (Btu/lb)	1,129
Cooking energy efficiency (%)	54.4

Light-Load: *See Comments, Deviations and Exceptions*

Test voltage (V)	
Higher heating value of natural gas (Btu/ft^3)	
Cooking time (min)	
Production rate (lb/h)	
Energy to food (Btu/lb)	
Cooking energy rate (Btu/h)	
Electric energy rate (kW)	
Energy per pound of food cooked (Btu/lb)	
Cooking energy efficiency (%)	

[1] Test results based on the average of three (3) iterations

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Performance of Open Deep Fat Fryer
UNCERTAINTY RESULTS FOR COOKING ENERGY EFFICIENCY
Annex A1.

Make:	Royal
Model:	REEF-35
Equipment Type:	Full-size fryer
Calculations from:	ASTM F 1361-07
Results Evaluated:	Cooking Energy Efficiency (%)

A. Iteration results

1.	Iteration 1	X_1 = 54.0
2.	Iteration 2	X_2 = 54.2
3.	Iteration 3	X_3 = 54.8
4.	Iteration 4	X_4 =
5.	Iteration 5	X_5 =

B. Uncertainty results

Average **Xa_n =**	54.4
Standard deviation **S_n =**	0.40
Absolute Uncertainty **U_n =**	0.99
Uncertainty Percent **$\%U_n$ =**	1.8

Performance of Open Deep Fat Fryer
UNCERTAINTY RESULTS FOR PRODUCTION RATE
Annex A1.

Make:	Royal
Model:	REEF-35
Equipment Type:	Full-size fryer
Calculations from:	ASTM F 1361-07
Results Evaluated:	Production Rate (lb/h)

C. Iteration results

1.	Iteration 1	X_1 = 59
2.	Iteration 2	X_2 = 61
3.	Iteration 3	X_3 = 60
4.	Iteration 4	X_4 =
5.	Iteration 5	X_5 =

D. Uncertainty results

Average **Xa_n =**	60
Standard deviation **S_n =**	0.67
Absolute Uncertainty **U_n =**	1.7
% Uncertainty **$\%U_n$ =**	2.8

Signatures: The undersigned has performed stated tests and has verified that the results recorded were the actual results observed.

SCG's Tester: _____ January 31, 2017
(signature) (date)

Jose Urzua
(print name)